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BELT INSECTS IN THE NORTHERN GREAT PLAINS

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ABSTRACT

An insect key designed to help identify 227 insect species. The text contains 136 figures and 8 color plates to aid in identification. Several tables assist in coordinating host damage with a particular insect species.

Key words: shelterbelt insects, Great Plains forestry, windbreaks.

KEY TO SHELTERBELT INSECTS ✓
IN THE NORTHERN GREAT PLAINS

by

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PREFACE

Trees and shrubs are planted throughout the Great Plains for various reasons: crop and soil protection, livestock protection, wildlife habitat, noise abatement, snow fences, beautification, and privacy screens. These trees represent a considerable investment of both public and private funds to obtain the intended benefits.

Establishing shelterbelts on the prairie provides a favorable habitat for tree pests which could not otherwise exist in the region. These potential pests must injure the tree to survive. If the injury results in a damaged tree, then the insect or mite must be correctly identified for application of recommended control measures.

This publication is designed as an aid in identification of insects for those who have no specialized training in entomology. Numerous illustrations are included for ease of identification and to insure discrimination among similar insect species. Insects are identified by proceeding through a series of alternative choices presented in brief paired statements (couplets). Included in the final couplets are principal hosts and time of insect occurrence. A glossary of terms used throughout the key is provided in the appendix. Also in the appendix is a list of the common and botanical names of the trees and shrubs mentioned.

The majority of insects defoliating trees in North and South Dakota are larvae of moths, butterflies, and sawflies. Since chewing of foliage is not distinctive, identifying characteristics of the insect rather than the damage are included in certain portions of the key. Characteristics given for immature forms are based upon last instar larvae unless otherwise stated.

The individual who encounters an insect or insect damage in a shelterbelt should note: (1) the kind of injury and its appearance, (2) the tree species, and (3) the general appearance of the insect doing the damage. With this information he can be relatively sure of obtaining an identification. In the case of defoliation, it is usually imperative that the insect causing the damage be well preserved for correct identification. Larvae stored in alcohol may lose their color and may not be identified correctly in this key. Where damage is diagnostic, the insects have not been described.

To use the key, examine the insect or damage and place it into one of the four Major Damage Categories. Identification is then

made by going through a series of opposing alternatives, one of which should apply to the specimen. Each alternative gives either a number referring to the next pertinent couplet, or a name identifying the specimen. Couplets have a number in parentheses which refers back to the previously used couplet. Therefore, one is able to retrace his steps in the key if he makes a mistake.

Example: Assume that warty eruptions were found on a leaf blade of green ash. Each gall was enclosed and protruded from both the upper and lower leaf surfaces. The description fits the Major Damage Category of gall-making insects and mites. Therefore, we start with couplet 1 in section II of the key.

Couplet 1 gives a choice between deciduous trees and spruce trees. The damage occurred on a deciduous tree, which leads us to 2. A series of hosts is listed in couplet 2. The damage occurred on green ash, which directs us to 12. Couplet 12 presents a choice between buds and leaves or staminate flowers. The leaves are affected, therefore we continue to 13. Couplet 13 presents the alternative of midvein or leaf blade. The leaf blade is affected, which refers us to 15. Couplet 15 gives a choice between galls or tightly rolled leaves. The obvious choice is the gall. Therefore, the damage is caused by a beadtype gall mite (*Aceria chondriphora*).

Information contained in the key was obtained from material collected in North Dakota and South Dakota. However, the key should be appropriate for portions of Montana, Wyoming, Nebraska, Minnesota, and Iowa.

MAJOR DAMAGE CATEGORIES

Defoliating Insects (Section I)

Insects feed directly on the leaves and needles of deciduous or evergreen trees and shrubs. Insects may roll, fold, or tie leaves or produce extensive webbing. This section includes adult and immature insects Page 1

Gall-Making Insects and Mites (Section II)

Galls appear as abnormal woody growths or swellings on twigs and branches, closed leaf galls, warty eruptions on leaf blades, rosette-type leaf clusters, or abnormal fruit. All aphids found in leaf curls are included with the sap-sucking insects (Section IV) Page 54

Boring and Leaf-Mining Insects (Section III)

Insects feed internally on woody tissue, fruit, seeds, or leaves. Borers associated with abnormal swellings are included with the gall-making insects (Section II) Page 83

Sap-Sucking Insects (Section IV)

Insects feeding on plant sap produce puncture wounds, stippled discoloration, or leaf curl; scale insects Page 131

SECTION I. DEFOLIATING INSECTS

Insects feed directly on leaves and needles of deciduous or evergreen trees and shrubs. The insect may roll, fold, or tie leaves or produce extensive webbing.

1.	Insect rolls, folds, or webs leaves	2
1'.	Insect defoliates without webbing or leaf distortion	16
2(1).	Leaves rolled or folded	3
2'.	Leaves webbed together, or have a silken mat	8
3(2).	Leaves folded	4
3'.	Leaves rolled	6
4(3).	Found on bur oak	5
4'.	Found on cottonwood. Leaves folded toward ventral surface (fig.1), inner surface skeletonized. Larvae present during early summer. <i>Phyllocolpa bozemani</i> (Cooley)	poplar leaf-folding sawfly



Figure 1.—Poplar leaf-folding sawfly (*Phyllocolpa bozemani*) on cottonwood leaf.

- 5(4). Leaf margin folded (fig. 2). Larvae present during summer. *Itonida* sp. a leaffolding fly
- 5'. Leaf lobe folded (fig. 3). Larvae present during summer. *Cecidomyia* sp. a leaffolding fly



Figure 2.—*Itonida* sp. on bur oak.



Figure 3.—*Cecidomyia* sp. on bur oak.

- 6(3). Leaf roll without prominent silken frass tube7
- 6'. Leaf roll with prominent silken frass tube (fig. 4). Bur oak. Larvae present from July to September. *Acrobasis* sp. a leafrolling moth



Figure 4.—*Acrobasis* sp. on bur oak. Note silk tube with incorporated frass. Larva skeletonize inner surface of leaf roll.

- 7(6). Feeds on boxelder (fig. 5). Larvae present from June to August. *Gracillaria negundella* Chambers
..... boxelder leafroller
- 7'. Feeds on green ash. Head, thoracic legs (fig. 7) and cervical shield light brown to black; body light green to dusky gray (fig. 6). Larvae present from June to July. *Archips argyrospilus* (Walker)fruittree leafroller
- 8(2). Larvae construct silken mats on ventral leaf surface. .9
8'. Larvae web or tie leaves together10



Figure 5.—Boxelder leafroller (*Gracillaria negundella*).

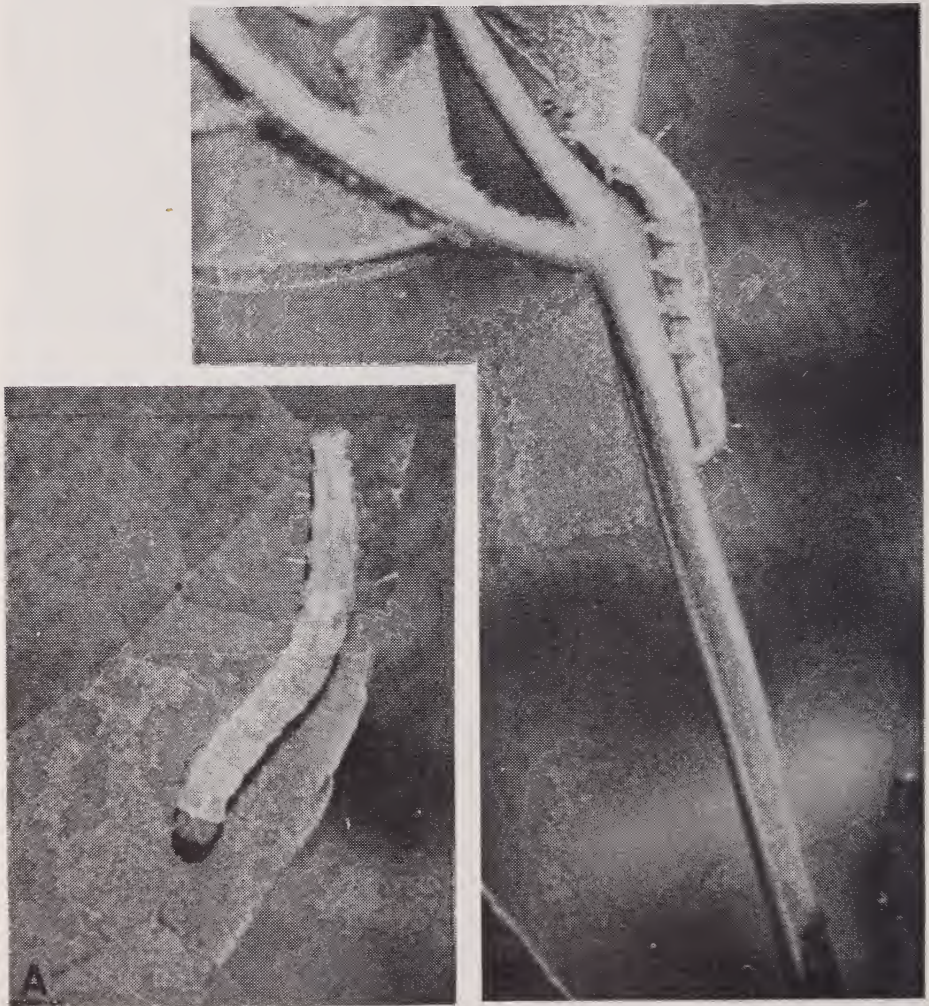


Figure 6.—Fruittree leafroller (*Archips argyrospilus*): A, dorsal view of last instar male larva; B, lateral view ; C, p. 5.



Figure 6C.—Dark phase larva inside leaf roll.

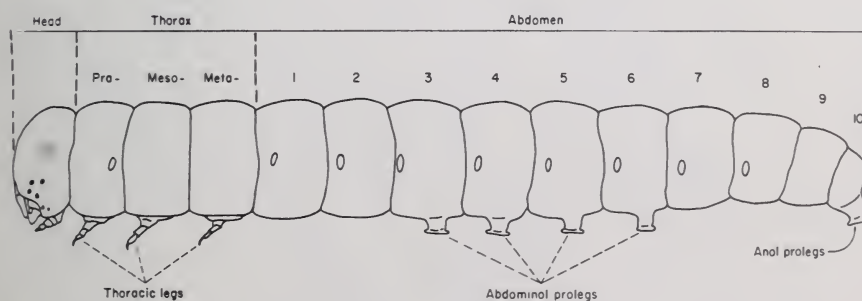


Figure 7.—Generalized drawing of a caterpillar.

- 9(8). Found on American elm. Larvae skeletonize lower leaf surface. Head and body light green to reddish brown flecked with white; prothorax, mesothorax, and 8th abdominal segment (fig. 7) with a black spot; prominent setae. Larvae present from June to August. *Psorosina hammondi* (Riley) appleleaf skeletonizer
- 9'. Found on boxelder (fig. 8). Larvae skeletonize lower leaf surface. Head dark brown with black eye spots, body pale yellow. First, second, and third instar larvae present on leaves from July to October. *Proteoteras willingana* (Kearfott) boxelder twig borer



Figure 8.—Boxelder leaf skeletonized by third instar larvae of the boxelder twig borer (*Proteoteras willingana*).

10(8).	Larvae construct large tents or webs; gregarious defoliator	11
10'.	Larvae web 2 or 3 leaves together; solitary defoliator. Head and body light green, prothorax and mesothorax (fig. 7) with dark spot on the side. American elm. Larvae present from July to October, two generations per year. <i>Canarsia ulmiarrosorella</i> (Clemens)	a leaftieing moth
11(10).	Tents in branch forks	12
11'.	Tents not in branch forks	14
12(11).	Head brown or black	13
12'.	Head blue mottled with black, body black with pale blue areas, interrupted white stripe down center of back (plate 6; fig. 9). Webbing contains frass and cast larval skins (fig. 9a). Common chokecherry, Siberian elm, Peking cotoneaster, rose. Larvae present from May to July. <i>Malacosoma californicum lutescens</i> (Neumoegen & Dyar)	prairie tent caterpillar



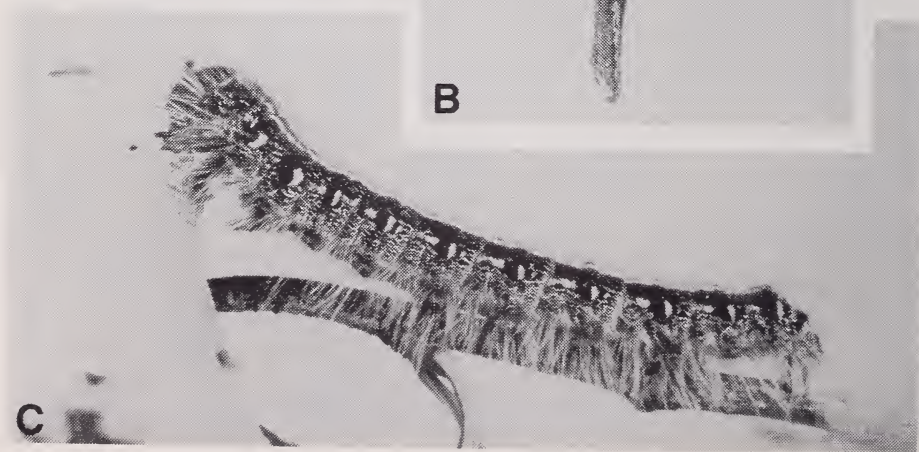
Figure 9.—Defoliation and webbing of the prairie tent caterpillar (*Malacosoma californicum lutescens*) on chokecherry.

- 13(12). Body pale yellow with a dark stripe down the back, head dark brown to black, setae long (plate 4; fig. 10). American plum, common chokecherry, willows, cottonwood, American elm, Siberian elm. Larvae present from July to October. *Hyphantria cunea* (Drury) fall webworm
- 13'. Body black with pale blue areas, interrupted white stripe down center of the back, head black, setae long (fig. 11). Common chokecherry. Larvae present from May to June. *Malacosoma americanum* (F.) eastern tent caterpillar



Figure 10.—Fall webworm (*Hyphantria cunea*): A, larvae and typical leaf skeletonizing; B, webbing in branch forks, characteristics of early instar larvae of both fall webworm and eastern tent caterpillar.





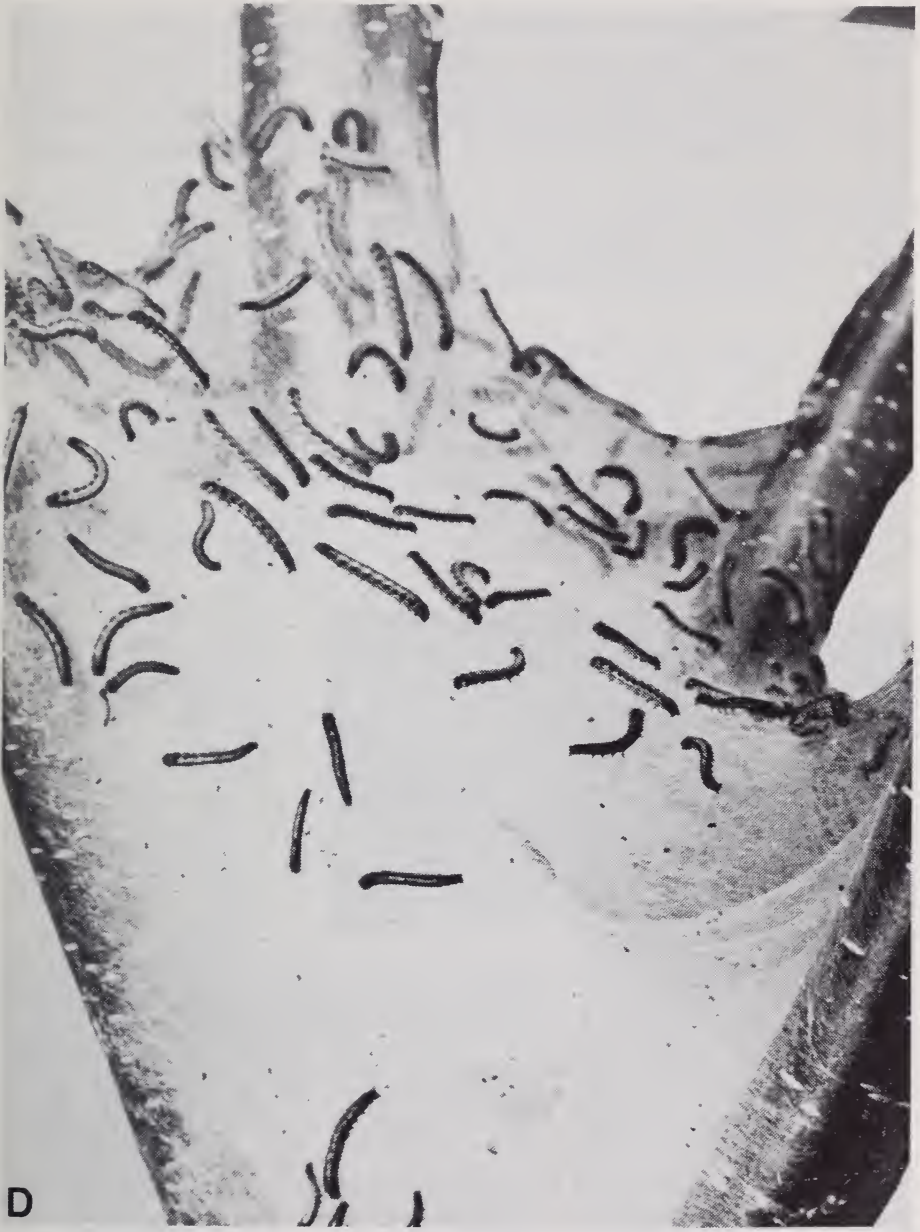


Figure 11.—Eastern tent caterpillar (*Malacosoma americanum*):
A, adults; B, egg mass; C, larva; D, larvae and
webbing in branch fork.

- 14(11). Head blue or black15
- 14'. Head light yellow, body white, thoracic legs and cervical shield black, prolegs reduced. American plum, sand cherry. Larvae present during the summer. *Neurotoma inconspicua* (Norton) plum webspinning sawfly
- 15(14). Head black, body yellowish white (fig. 12). Webbing contains frass. Common chokecherry. Larvae present from May to September. *Archips cerasivoranus* (Fitch) uglynest caterpillar
- 15'. Head blue mottled with black, body black with pale blue areas, interrupted white stripe down center of back (plate 6; fig. 9). Webbing contains frass and cast larval skins. Common chokecherry, Siberian elm, Peking cotoneaster, rose. Larvae present from May to July. *Malacosoma californicum lutescens* (Neumoegen & Dyar) prairie tent caterpillar



Figure 12.—Uglynest caterpillar (*Archips cerasivoranus*): A, webbed foliage; B, larvae.

16(1).	Insect with wings or wing pads	17
16'.	Insect without wings	32
17(16).	Front pair of wings (elytra) meeting in straight line down the back (fig. 13), leathery, veins absent.	
	Beetles	18
17'.	Front pair of wings not meeting in a straight line, leathery, veins present. Grasshoppers	30

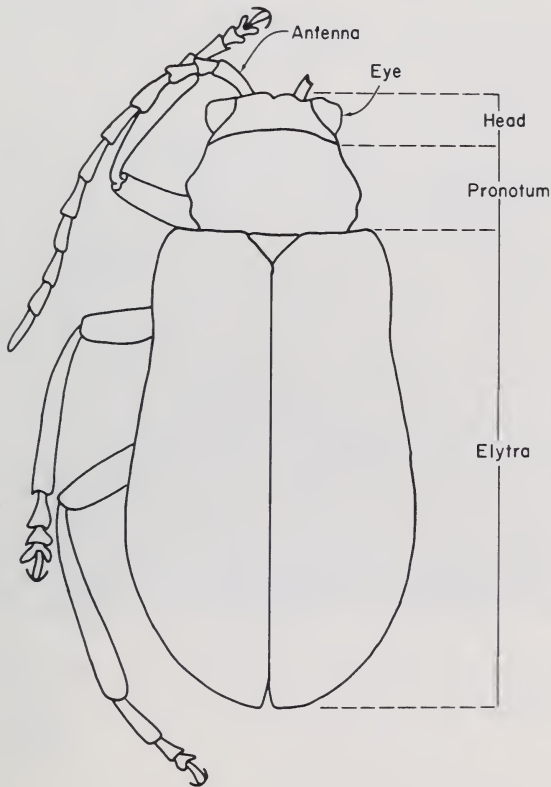


Figure 13.—Generalized drawing of a beetle.

18(17).	Mouthparts elongate and snoutlike (fig. 15a), antennae elbowed and club shaped (fig. 14a)	19
18'.	Mouthparts not snoutlike, antennae filiform (fig. 17) or lamellate (fig. 10b)	20

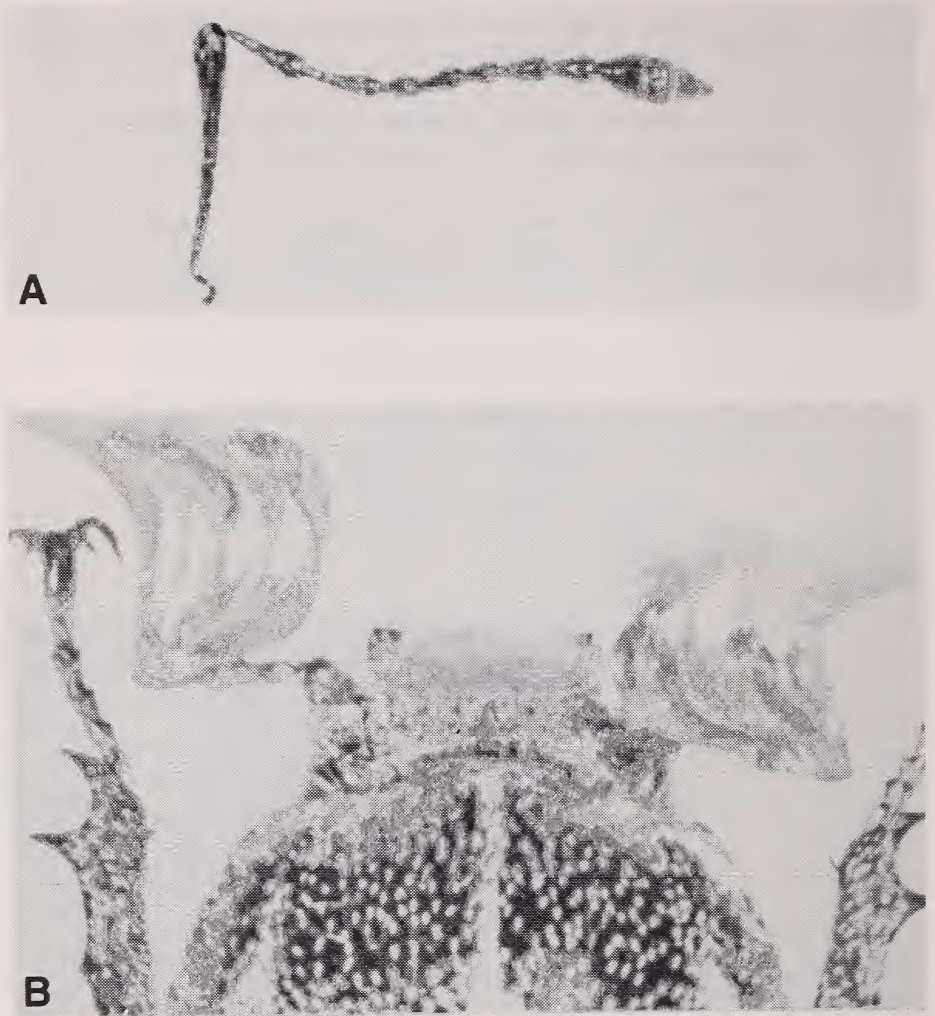


Figure 14.—Types of antennae: A, elbowed and club shaped; B, lamellate.

- 19(18). Feeds on American elm, Siberian elm. Body dull reddish brown, front wings with longitudinal lines coarsely punctate (fig. 15). Adults present from July to August, shot hole type defoliation. *Magdalis armicollis* (Say). red elm bark weevil
- 19'. Feeds on white willow. Body brown to black, gray oblique band at end of forewing (fig. 16). Adults present from July to August, feed on foliage and gouge notches in current season's growth. *Cryptorhynchus lapathi* (L.) poplar-and-willow borer



Figure 15.—Red elm bark weevil (*Magdalis armicollis*): A, adult, length 7 mm or less; B, adult and shot hole defoliation.

- | | | |
|---------|---|----|
| 20(18). | Lamellate antennae (fig. 14b), leaflike segments forming a club, antennae shorter than head and pronotum. June beetles | 21 |
| 20'. | Filiform antennae, longer than head and pronotum (fig. 13) | 24 |
| 21(20). | Body with metallic sheen | 22 |
| 21'. | Body without metallic sheen | 23 |



Figure 16.—Poplar-and-willow borer (*Cryptorhynchus lapathi*) length 7-10 mm; normal twig on the left and damaged twig on the right.



Figure 17.—*Dichelonyx subvittata* length 10 mm.

- 22(21). Head and pronotum (fig. 13) light brown, elytra brown with metallic green (fig. 17). Hardwoods. Adults present from July to August. *Dichelonyx subvittata* (LeConte) a June beetle
- 22'. Head and pronotum metallic yellowish green, elytra lemon yellow to gold (fig. 18). White willow, cottonwood. Adults present from June to July. *Cotalpa lanigera* (L.) goldsmith beetle



Figure 18.—Goldsmith beetle (*Cotalpa lanigera*), length 20-25 mm.



Figure 19.—*Polyphylla hammondi*, length 26 mm.

- 23(21). Head and body dark brown, elytra (fig. 13) with indistinct gray longitudinal lines (fig. 19), medium to dark brown hair on underside of the body. White willow. Adults present during July. *Polyphylla hammondi* LeConte a June beetle
- 23'. Head dark brown, pronotum and elytra (fig. 13) with yellowish-green tinge, elytra with white lines (fig. 20), light tan hair on underside of the body. White willow. Adults present during July. *Polyphylla decemlineata* (Say) tenlined June beetle



Figure 20.—Tenlined June beetle (*Polyphylla decemlineata*), length 27-30 mm.

24(20).	Pronotum narrower than the head and body.	
	Blister beetle25
24'.	Pronotum wider than the head (fig. 13).	
	Leaf beetle27
25(24).	Body nonmetallic dark color26
25'.	Body metallic purple with a green sheen. Siberian peashrub. Adults present from May to June. <i>Lytta nuttallii</i> Say	Nuttall blister beetle
26(25).	Head and body ash gray (fig. 21). Siberian peashrub. Adults present from May to June. <i>Epicauta fabricii</i> (LeConte)	ashgray blister beetle
26'.	Head and body black. Siberian peashrub. Adults present from May to June. <i>Epicauta subglabra</i> (Fall)	caragana blister beetle



Figure 21.—Ashgray blister beetle (*Epicauta fabricii*) on caragana, length 15-25 mm.

- 27(24). Body yellowish green to light brown, marked with spots or stripes28
- 27'. Body metallic purplish blue, elytra smooth with a prominent ridge parallel to the outer margin. Common chokecherry, willow. *Altica plicipennis* (Mannerheim) a chrysomelid leaf beetle
- 28(27). Pronotum (fig. 13) yellow with 2 or 3 black spots ..29
- 28'. Pronotum black with yellow sides, elytra greenish yellow with black markings (fig. 22). Cottonwood, white willow. Adults present from June to August. *Chrysomela scripta* F.cottonwood leaf beetle



Figure 22.—Cottonwood leaf beetle (*Chrysomela scripta*).

- 29(28). Pronotum yellow with 2 black spots, elytra yellow with a black stripe along the suture and lateral margin, a third stripe down center of elytra, head orange with black eyes (fig. 23). White willow. Adults active during August. *Disonycha alternata* (Illiger)
 a chrysomelid leaf beetle
- 29'. Pronotum yellow with 3 black spots, elytra yellowish green with black lateral stripe (fig. 24). American elm, Siberian elm. Adults active during May and August. *Pyrrhalta luteola* (Muller) elm leaf beetle



Figure 23.—*Disonycha alternata*: A, adult, length 7-8 mm; B, adult defoliating willow.

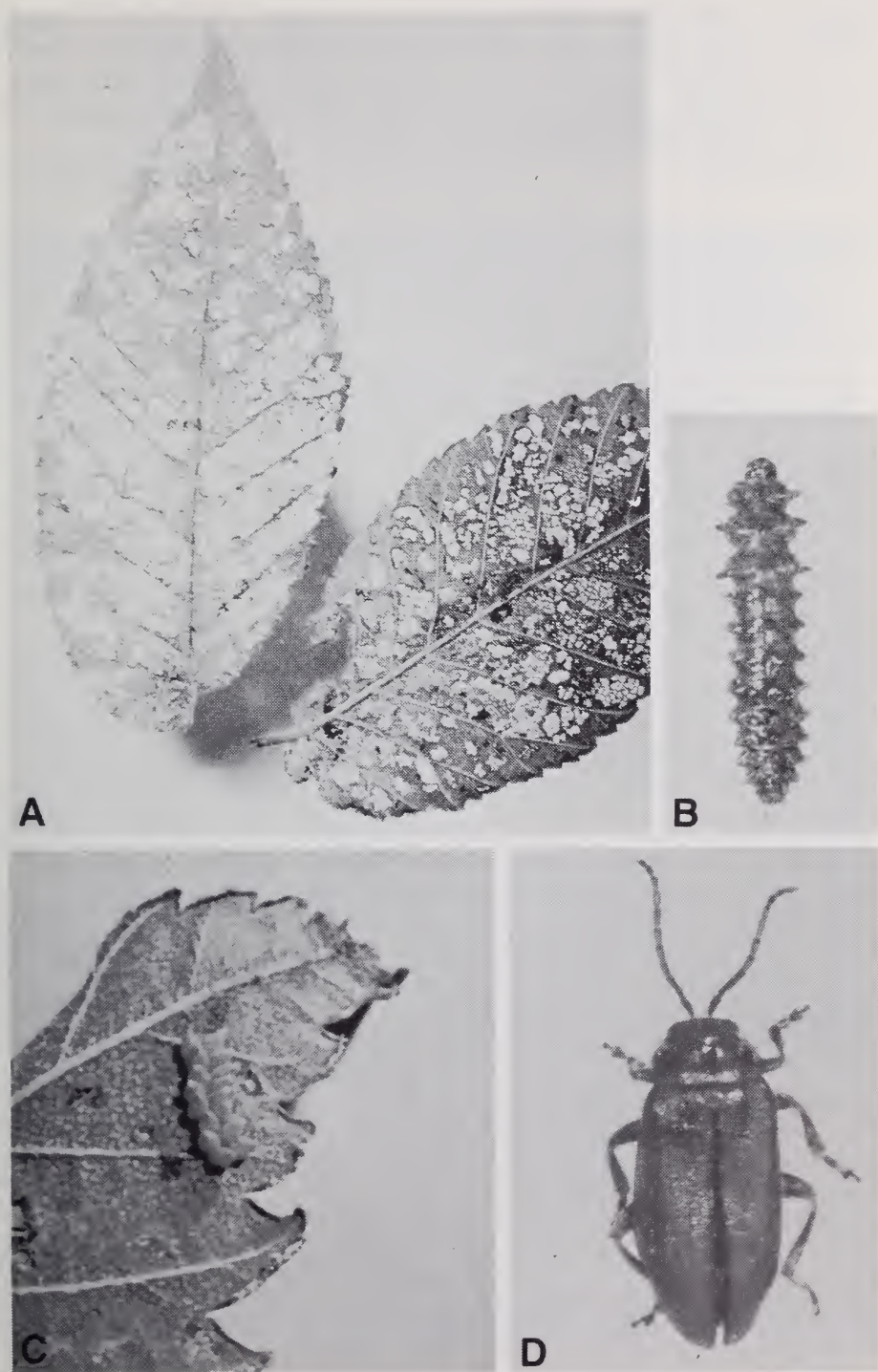


Figure 24.—Elm leaf beetle (*Pyrrhalta luteola*): A, skeletonized leaf; B, larva; C, eggs; D, adult, length 5-7 mm.

- 30(17). Hind legs yellowish brown to brown31
 30'. Hind legs red. American elm, Siberian elm, bur oak, Siberian peashrub (fig. 25), common lilac, American plum, tatarian honeysuckle. Present from August to September. *Melanoplus femurrubrum* (De Geer)
 redlegged grasshopper
- 31(30). Hind legs with black chevron markings, body brown. American elm, Siberian elm, Siberian peashrub (fig. 25), American plum, Russian-olive. Present from July to September. *Melanoplus sanguinipes* (F.)
 migratory grasshopper
- 31'. Hind legs without black chevron markings, body dark brown, two light tan longitudinal stripes from the head to tip of the wings. American elm, Siberian elm, American plum, Siberian peashrub (fig. 25), sand cherry, boxelder, Peking cotoneaster. Present from July to September. *Melanoplus bivittatus* (Say)
 twostriped grasshopper



Figure 25.—Defoliation of caragana by grasshoppers (*Melanoplus* spp.).

- 32(16). Antennae short, less than half the body length,
 abdomen soft and fleshy33
- 32'. Antennae long, equal to half the body length,
 abdomen sclerotized. Long slender insect with thin legs
 (fig. 26). Bur oak. Feeding from June to September.
 Diapheromera femorata (Say) walkingstick



Figure 26.—Walkingstick (*Diapheromera femorata*).

- 33(32). Prolegs absent on all abdominal segments.
 Beetle larvae34
- 33'. Prolegs present on two or more abdominal segments.
 Sawflies, caterpillars (figs. 7,27).....35
- 34(33). Larva black turning dull yellow with age, abdominal segments with 6 rows of spots (fig. 22). Cottonwood. Larvae present during the summer.
Chrysomela scripta F. cottonwood leaf beetle
- 34'. Larva yellow, body has black bands down the back with setae between the bands (fig. 24). American elm, Siberian elm. Larvae present from May to June.
Pyrrhalta luteola (Muller) elm leaf beetle
- 35(33). Prolegs present on abdominal segments 2-8, 10 (fig. 27). Sawflies36
- 35'. Prolegs absent on abdominal segments 1, 2, 7, 8, and 9 (fig. 7). Caterpillars46

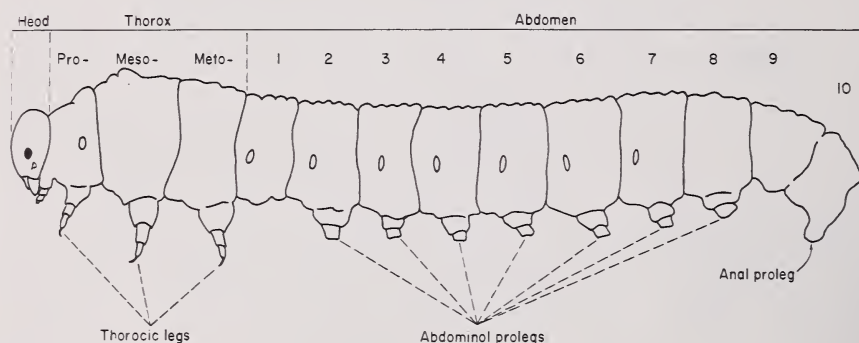


Figure 27.—Generalized drawing of a sawfly.

- 36(35). Head light brown, gray, offwhite, or yellowish orange
37
- 36'. Head dark brown or black39
- 37(36). Head offwhite or light brown38
- 37'. Head yellowish orange, body yellowish green with dark green stripes down the back and sides (fig. 28). White spruce, blue spruce (plate 8). Larvae present from July to August. *Pikonema alaskensis* (Rohwer)
 yellowheaded spruce sawfly

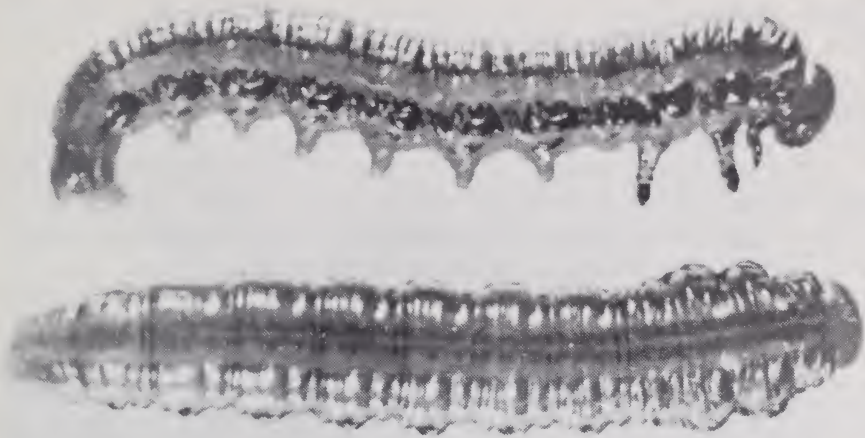


Figure 28.—Yellowheaded spruce sawfly (*Pikonema alaskensis*).

- 38(37). Head offwhite, body offwhite with black spiracles and black dorsal stripe (fig. 29). American elm, Siberian elm, white willow. Larvae present from July to September. *Cimbex americana* Leach elm sawfly
- 38'. Head light brown with reddish-brown markings, body light green with whitish dorsal stripe. Each body segment outlined front and back with a definite white line. White willow. Larvae present from June to September, two or more generations per year. *Nematus mendicus* Walsh a willow sawfly



Figure 29.—Elm sawfly (*Cimbex americana*) larva at rest on Siberian elm.

- 39(36). Body white40
 39'. Body yellowish green, dark green, gray or black41
- 40(39). Thorax swollen, body translucent white (fig. 30). Head black. Bur oak. Larvae present from July to August. *Caliroa* sp.a slug sawfly
- 40'. Thorax not swollen, body solid white. Head black (plate 2). Green ash. Larvae present from May to June. *Tethida cordigera* (Palisot de Beauvois)
blackheaded ash sawfly



Figure 30.—A slug sawfly (*Caliroa* sp.) skeletonizing the underside of bur oak leaf.

- 41(39). Head brown42
- 41'. Head black43
- 42(41). Body grayish green with yellow spots and irregular rows of black dots. Tatarian honeysuckle. Larvae present from June to July. *Zaraea inflata* Norton honeysuckle sawfly
- 42'. Body olive green due to secretion of slime. Thorax swollen (plate 3). American plum. Larvae present from June to July. *Caliroa cerasi* (L.) pearslug
- 43(41). Feeds on willow, pine44
- 43'. Feeds on tamarack, Siberian larch. Body yellowish green with dorsal gray band (plate 2). Larvae present from June to September. *Pristiphora erichsonii* (Hartig) larch sawfly



Figure 31.—Willow sawfly (*Nematus ventralis*) feeding on *Salix*.

- 44(43). Body grayish or yellowish green45
 44'. Body dark brown to black, sides of each body segment with yellow spots (fig. 31). Cottonwood, white willow. Larvae present from June to July. *Nematus ventralis* Say willow sawfly
- 45(44). Body grayish green with a light dorsal stripe; dark green stripe down the side with black patch on top of last body segment (fig. 32). Scotch pine, Austrian pine. Larvae present from May to June. *Neodiprion sertifer* (Geoffroy) European pine sawfly
- 45'. Body yellowish green; sides mottled in black, two black stripes down the back (fig. 33). Ponderosa pine, Scotch pine. Larvae present from July to October. *Diprion similis* (Hartig)introduced pine sawfly

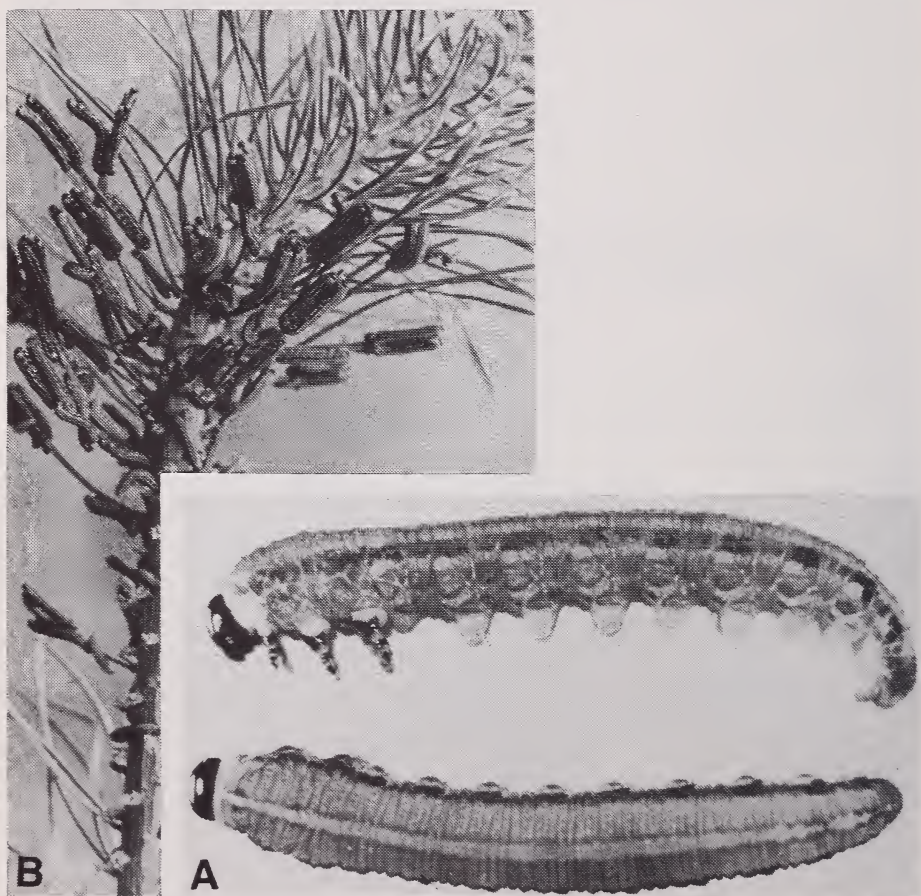


Figure 32.—European pine sawfly (*Neodiprion sertifer*): A, dorsal and lateral view of larvae; B, larvae defoliating Scotch pine.

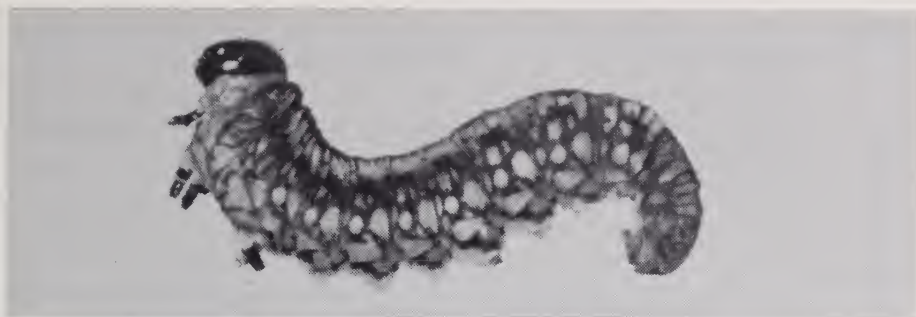


Figure 33.—Lateral view of the introduced pine sawfly (*Diprion similis*).

- | | | |
|---------|---|----|
| 46(35). | Prolegs present on abdominal segments 3 and 4 (figs. 7, 34) | 47 |
| 46'. | Prolegs absent on abdominal segments 3 and 4 (fig. 51) | 76 |
| 47(46). | Head with rough texture. Body may or may not have prominent spines or clubs | 48 |
| 47'. | Head with smooth texture. Body without prominent spines | 51 |
| 48(47). | Larvae have more than five body segments with prominent spines (fig. 34) | 49 |
| 48'. | Larvae have less than five body segments with prominent spines or clubs (fig. 36) | 50 |

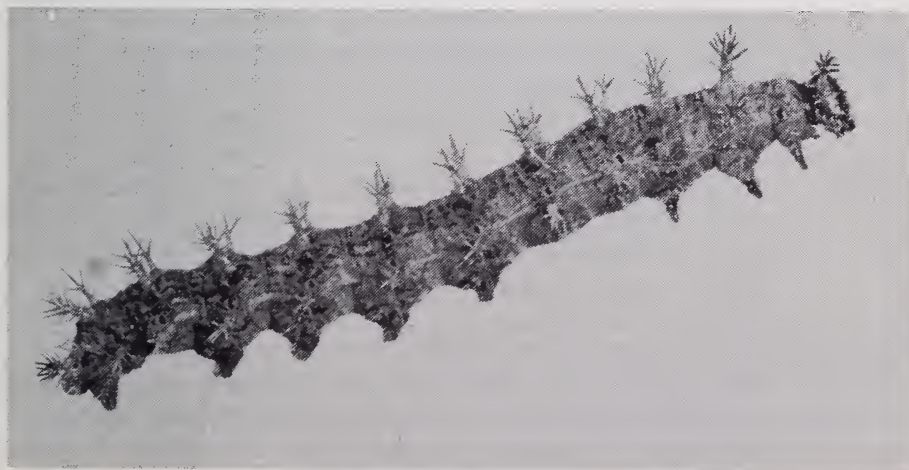


Figure 34.—Violet tip caterpillar (*Polygonia interrogationis*).

- 49(48). Head orange with a pair of branched spines, body reddish brown with black-tipped orange spines (fig. 34). American elm, Siberian elm. Larvae present during July. *Polygonia interrogationis* F. . violet tip caterpillar
- 49'. Head black with no spines, body black with black spines and a row of orange spots down the back (fig. 35). Colonial feeder. American elm, Siberian elm, white willow. Larvae present from June to July. *Nymphalis antiopa* (L.) mourningcloak butterfly

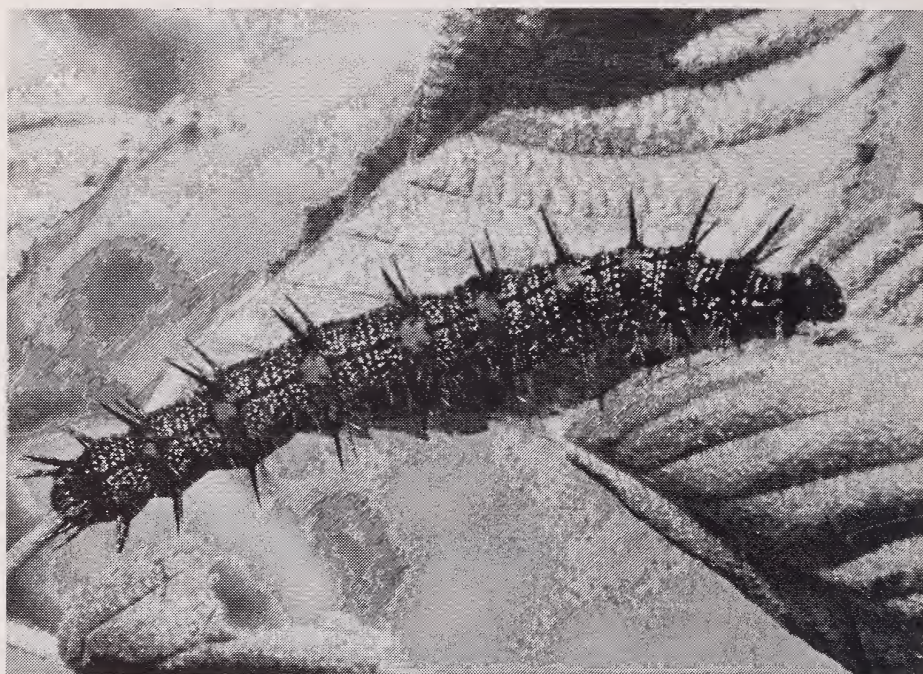


Figure 35.—Mourningcloak butterfly (*Nymphalis antiopa*).

- 50(48). Clublike structures present on second thoracic segment, body yellowish brown or green with a white patch near center of back (fig. 36). Cottonwood, white willow. Larvae present from April to August. *Limenitis archippus* (Cramer) viceroy
- 50'. Clublike structures absent on second thoracic segment, body pale green with yellowish dorsal stripe edged with blue and yellow. Head with branched "antlers." Hackberry. Larvae present from June to August. *Asterocampa celtis* Boisduval & LeConte
. hackberry caterpillar



Figure 36.—Viceroy butterfly (*Limenitis archippus*).

- 51(47). Body with long setae (hair)52
- 51'. Body with short, sparse setae61
- 52(51) Head black, blue, or gray53
- 52'. Head white marked with black. Body white with long white hair. Cottonwood, white willow, bur oak. Larvae present from August to September. *Acronicta leporina vulpina* (Grote) a dagger moth
- 53(52). Body sparsely covered with long hair54
- 53'. Body densely covered with long hair56
- 54(53). Head pale blue or gray55
- 54'. Head black. Body black with a yellow cervical shield and yellow body stripes (plate 8; fig. 37). Colonial feeders. White willow, Saskatoon serviceberry, bur oak, American plum. Larvae present from July to September. *Datana ministra* (Drury)
..... yellownecked caterpillar

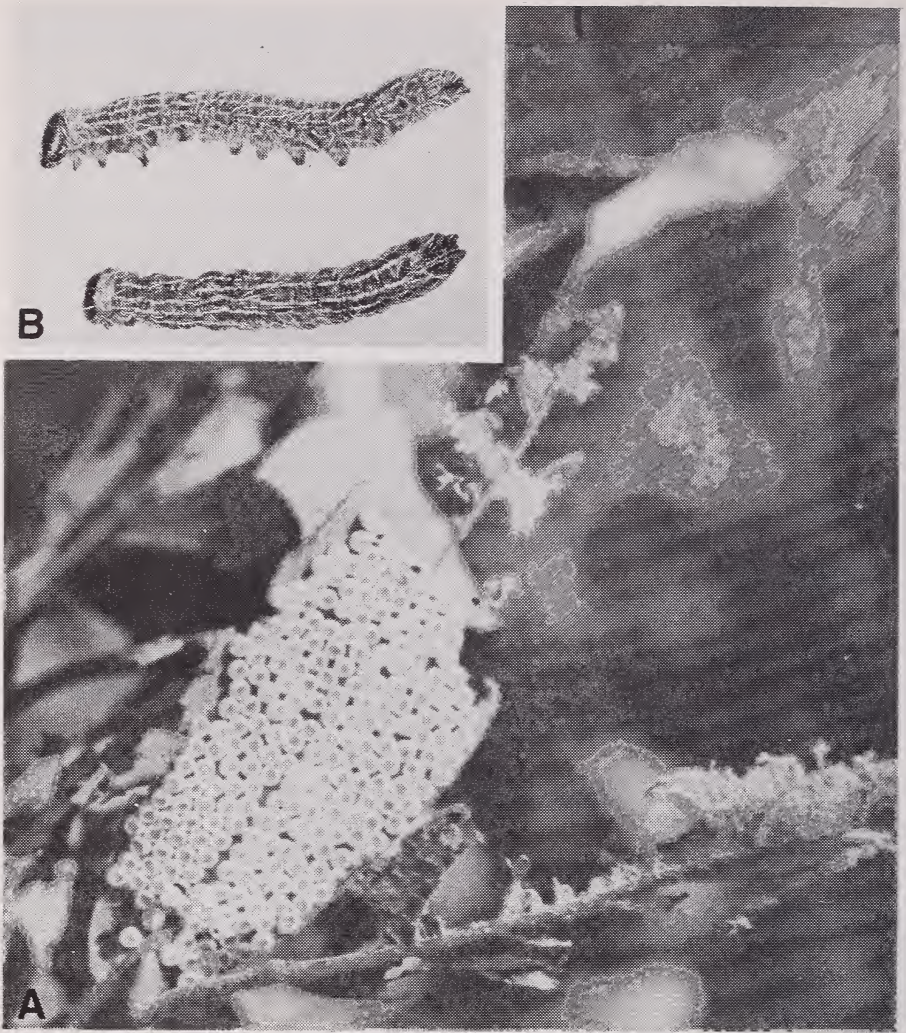


Figure 37.—Yellownecked caterpillar (*Datana ministra*): A, egg mass; B, mature larvae.

- 55(54). Head and body pale blue, body with keyhole shaped spots down the back (plate 6; fig. 38). Cottonwood, green ash, Peking cotoneaster, basswood, aspen. Larvae present from April to June. *Malacosoma disstria* Hübner forest tent caterpillar
- 55'. Head and body light gray, body depressed with hair fringe down each side (fig. 39). Metathorax (fig. 7) with black velvet band. White willow, green ash, bur oak, Siberian elm. Larvae present from June to August. *Tolyte velleda* (Stoll) Velleda lappet moth

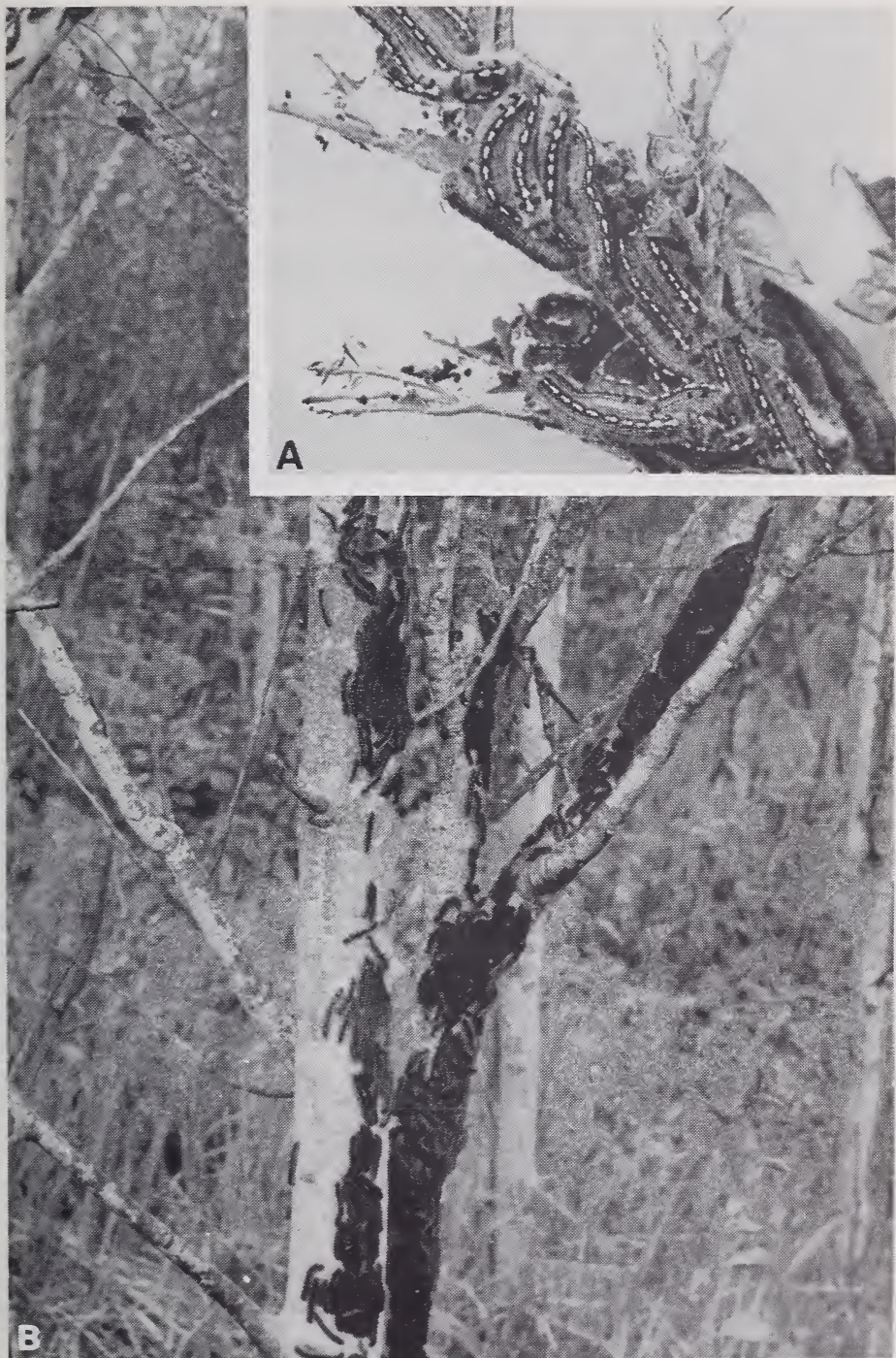


Figure 38.—Forest tent caterpillar (*Malacosoma disstria*): A, larvae defoliating Peking cotoneaster; B, larvae on aspen.

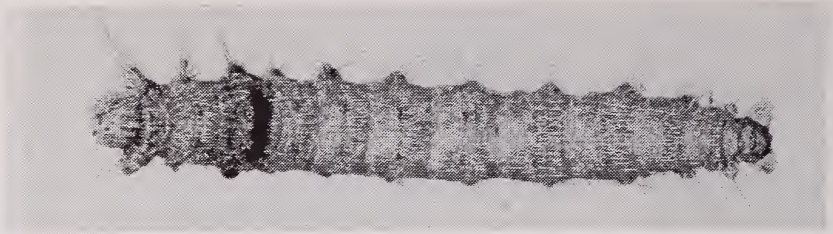


Figure 39.—Velleda lappet moth (*Tolyte velleda*).

- 56 (53). Long hair pencils present on 3rd abdominal segment (fig. 41) 57
- 56'. Long hair pencils absent on 3rd abdominal segment 59
- 57(56). Single black pencil on abdominal segments 1 and 3 58
- 57'. Pair of black pencils on abdominal segments 1 and 3. Single pencil on 8th abdominal segment, body pale yellow with pale yellow hair (fig. 40). Boxelder, cottonwood, green ash, bur oak. Larvae present from July to September. *Acronicta americana* (Harris) American dagger moth



Figure 40.—American dagger moth (*Acronicta americana*).

- 58(57). Body black and densely covered with reddish-brown hair, head black. Single black pencil on abdominal segments 1, 3, and 8 (plate 5; fig. 41). White willow, common chokecherry. Larvae present from July to September. *Acronicta dactylina* Grote
 a dagger moth
- 58'. Body white and densely covered with yellow hair, head black. Single black pencil on abdominal segments 1, 3-5, and 8. White willow, cottonwood. Larvae present from June to September. *Acronicta lepusculina* Guenée
 cottonwood dagger moth



Figure 41.—A dagger moth (*Acronicta dactylina*).

- 59(56). Feeds on hardwoods60
- 59'. Feeds on spruce. Head black, body with long pencils near head and tail, black and white tufts down each side, gray tufts on abdominal segments 1 to 4 (fig. 42). White spruce, blue spruce. Larvae present from June to July. *Dasychira* sp. a spruce tussock moth

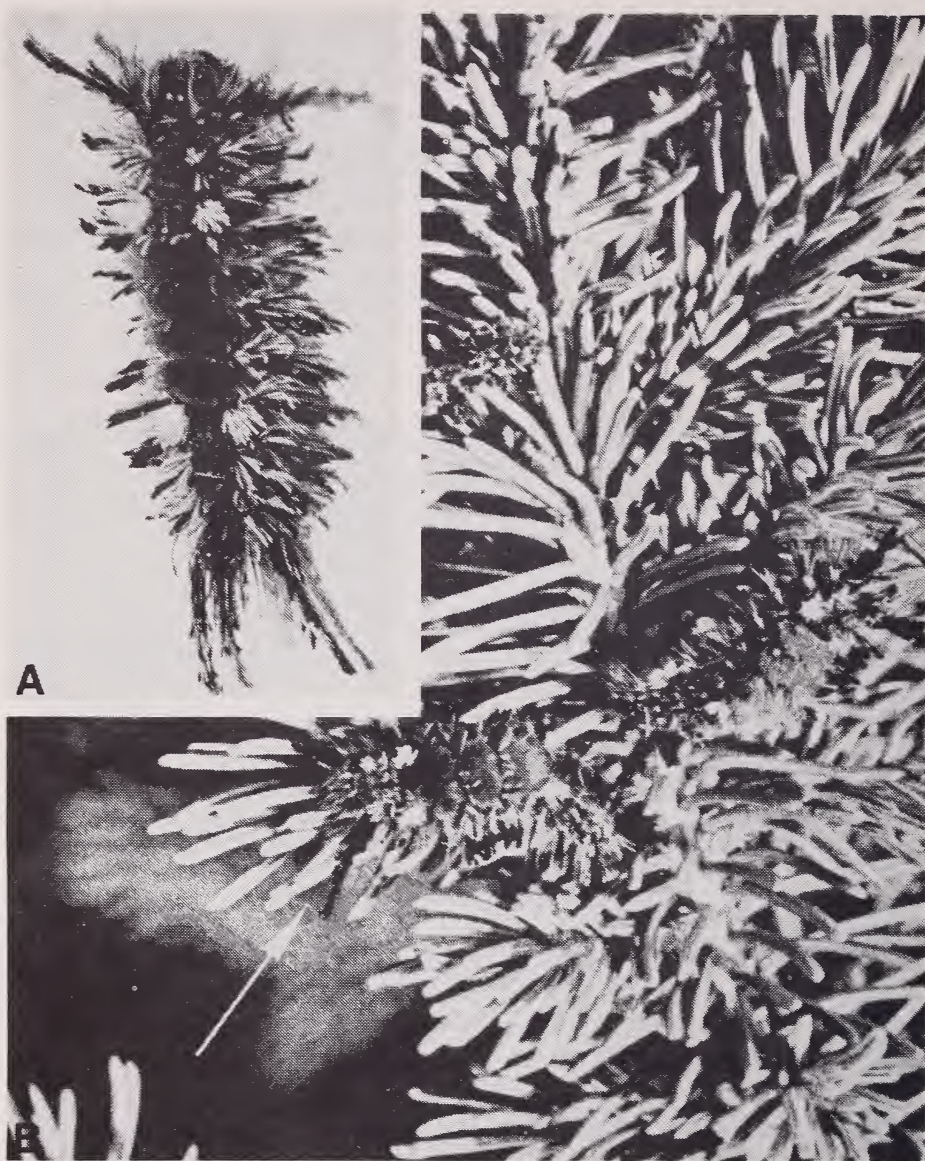


Figure 42.—A spruce tussock moth (*Dasychira* sp.): A, dorsal view; B, feeding on spruce.

- 60(59). Body with olive tinged yellowish-gray hair, black pencils near head and tail. Head and body black (fig. 43). American elm, Siberian elm, green ash, boxelder, bur oak, common chokecherry. Larvae present from July to September. *Halisidota tessellaris* (J. E. Smith)
 pale tussock moth

- 60'. Body with a row of black tufts down back and yellow tufts on side of abdominal segments 2—6 (fig. 44), longer tufts near head and tail. Head and body black. Boxelder, white willow, green ash, common chokecherry. Larvae present from July to October. *Halisidota maculata* (Harris) . . . spotted tussock moth
- 61(51). Larvae with tubercles, filaments, or dorsal humps . . . 62
- 61'. Larvae without tubercles, filaments, or dorsal humps . . . 73

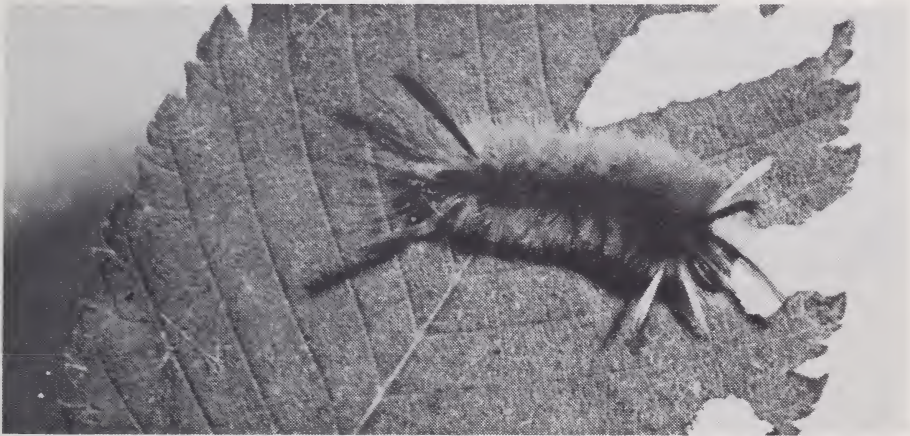


Figure 43.—Pale tussock moth (*Halisidota tessellaris*).



Figure 44.—Spotted tussock moth (*Halisidota maculata*).

- 62(61). Caudal horn or spinelike process present on 8th abdominal segment63
- 62'. Caudal horn or spinelike process absent on 8th abdominal segment65
- 63(62). No scoli present on thoracic segments64
- 63'. Two pair of scoli present on thoracic segments, head and body bluish green (plate 5). American elm, green ash. Larvae present from July to September. *Ceratomia amyntor* (Hübner) elm sphinx
- 64(63). Head yellowish green with red and yellow stripe. Body yellowish green marked with seven oblique purplish stripes edged below with white, caudal horn black above and yellow below. American plum, common chokecherry, sand cherry, hackberry. Larvae present from July to September. *Sphinx drupiferarm* Abbot & Smith hackberry sphinx
- 64'. Head bluish green with light green stripe. Body light green with seven oblique yellow stripes edged above with bluish green, caudal horn pale blue. Green ash, common lilac. Larvae present from July to September. *Sphinx chersis* (Hübner) great ash sphinx
- 65(62). Dorsal hump present on 8th abdominal segment ...66
- 65'. Dorsal hump absent on 8th abdominal segment ...68
- 66(65). Head orange or reddish orange67
- 66'. Head yellow, body pink to gray with three black dorsal lines. Reddish-orange enlargement on 8th abdominal segment (plate 1). Bur oak. Larvae present from August to October. *Symmerista albifrons* (J. E. Smith) redhumped oakworm
- 67(66). Body yellowish with five black dorsal lines, head orange. Orange enlargement on 8th abdominal segment. Bur oak. Larvae present from June to September. *Symmerista canicosta* Franclemont a redhumped oakworm
- 67'. Body pink to gray with five black dorsal lines, head reddish orange. Reddish-orange enlargement on 8th abdominal segment. Bur oak. Larvae present from August to October. *Symmerista albicosta* (Hübner) a redhumped oakworm

68(65).	Prominent projections (scoli) present on one or more thoracic segments	69
68'.	Prominent projections absent on all thoracic segments (fig. 7)	70
69(68).	Head bluish green shaded with brown. Body light green with six pink or green tubercles per segment. White willow, American elm, Siberian elm, paper birch. Larvae present from July to September. <i>Actias luna</i> (L.)	<i>luna moth</i>
69'.	Head yellowish green with two black spots. Body green with four coral-red tubercles on thoracic segments, two rows of yellow tubercles down the back, and two rows of blue tubercles down each side. White willow, green ash, boxelder, common lilac, common chokecherry. Larvae present from June to October. <i>Hyalophora cecropia</i> (L.)	<i>cecropia moth</i>
70(68).	Dorsal projection or hump present on 1st abdominal segment	71
70'.	Dorsal projection or hump absent on 1st abdominal segment. Head reddish brown. Body green with orange spiracles, orange or gold tubercles with a silvery tint on each segment, last body segment edged with purple (plate 1). White willow, cottonwood, American elm, Siberian elm, basswood, paper birch. Larvae present from June to October. <i>Antheraea polyphemus</i> (Cramer).	<i>polyphemus moth</i>
71(70).	Head green	72
71'.	Head purple with dark lines. Body reddish brown and marked with two oblique white stripes, bifurcate dorsal projections with a spine on each point (fig. 45). White willow, boxelder, paper birch. Larvae present from July to September. <i>Schizura ipomoeae</i> Doubleday	<i>false unicorn caterpillar</i>



Figure 45.—False unicorn caterpillar (*Schizura ipomoeae*) starting to molt (note old head capsule).

- 72(71). Body bluish green with dorsal projections on all abdominal segments. Head pale green with four white and two black lines. American elm, Siberian elm. Larvae present from June to September. *Nerice bidentata* Walker serrated elm caterpillar
- 72'. Body variegated white and brown with a dorsal projection on 1st abdominal segment (fig. 46). Mesothorax and metathorax (fig. 7) are green. Head green to brown. American elm, Siberian elm, white willow, common chokecherry. Larvae present from July to September. *Schizura unicornis* (J. E. Smith)
 unicorn caterpillar



Figure 46.—Unicorn caterpillar (*Schizura unicornis*).

- 73(61). Head green, dark brown, black74
73'. Head orange, reddish brown75
- 74(73). Spruce needles clipped and webbed together. Head dark brown or black, body pale yellow to dark brown with yellowish hair-bearing tubercles. Larvae present from bud break until June. *Choristoneura biennis* Freeman (plate 3). two-year-cycle budworm *Choristoneura fumiferana* (Clemens)
..... spruce budworm
- 74'. Hardwood leaves defoliated. Head green with red lateral stripe, body green to yellowish green with reddish-purple saddle-shaped patch on abdominal segments 3, 4, and 5. American elm, Siberian elm, white willow, common chokecherry, paper birch. Larvae present June to September. *Heterocampa guttivitta* (Walker) saddled prominent
- 75(73). Head orange with black and white lateral stripes. Body yellowish green with reddish-brown band bordered by a yellow stripe from base of head to the last abdominal segment (fig. 47). American elm, Siberian elm, bur oak, paper birch. Larvae present from July to September. *Heterocampa manteo* (Doubleday)
..... variable oakleaf caterpillar
- 75'. Head reddish brown, body yellowish green with reddish-brown band from the head to the 8th abdominal segment. Anal prolegs modified into tails. Willow. Larvae present from July to September. *Cerura prob. scolopendrina* (Boisduval) a twotailed caterpillar
- 76(46). Prolegs on abdominal segment 6, absent from segment 5 77
- 76'. Prolegs on abdominal segments 5 and 6, rudimentary pair on 5th segment. Body varies from brown to green with three white lines above spiracles and a yellow line below (fig. 48). American elm, Siberian elm, American plum, green ash, boxelder, common chokecherry. Larvae present from May to June. *Alsophila pometaria* (Harris) fall cankerworm



Figure 47.—Variable oakleaf caterpillar (*Heterocampa manteo*): A, defoliation; B, larva (light phase); C, larvae (dark phase).



Figure 48.—Fall cankerworm (*Alsophila pometaria*).

- 77(76). Head round or slightly notched78
 77'. Head deeply notched with blunt projections. Body brown to gray with short filaments on undersurface of abdominal segments 7 and 8 (plate 2; fig. 49). White willow, boxelder, tamarack, larch, paper birch, aspen. Larvae present from July to August. *Biston cognataria* (Guenée). pepper-and-salt moth



Figure 49.—Pepper-and-salt moth (*Biston cognataria*): A, larva; B, notched head.

- 78(77). Head dark brown79
 78'. Head yellow, body yellow with ten longitudinal black lines (plate 7). American elm, Siberian elm, sand cherry, boxelder, American plum. Larvae present from May to July. *Erannis tiliaria* (Harris) ... linden looper
- 79(78). Abdominal segments 2 and 3 with projections or swollen ridges80
 79'. Abdominal segments 2 and 3 without projections or swollen ridges. Body light brown to black with a yellow stripe below spiracles (plate 1, fig. 50). American elm, Siberian elm, American plum, boxelder, green ash, apple. Larvae present from May to July. *Paleacrita vernata* (Peck)spring cankerworm



Figure 50.—Spring cankerworm (*Paleacrita vernata*): A, damage to single row Siberian elm shelterbelt; B, larvae have consumed everything but leaf petioles.

- 80(79). First abdominal segment less than combined length of thoracic segments (fig. 7).81
- 80'. First abdominal segment equal to length of thoracic segments. Body light to dark brown with a raised transverse ridge on abdominal segments 2, 5, and 8 (fig. 51). American elm, Siberian elm. Larvae present from June to July. *Ennomos subsignarius* (Hübner)
 elm spanworm

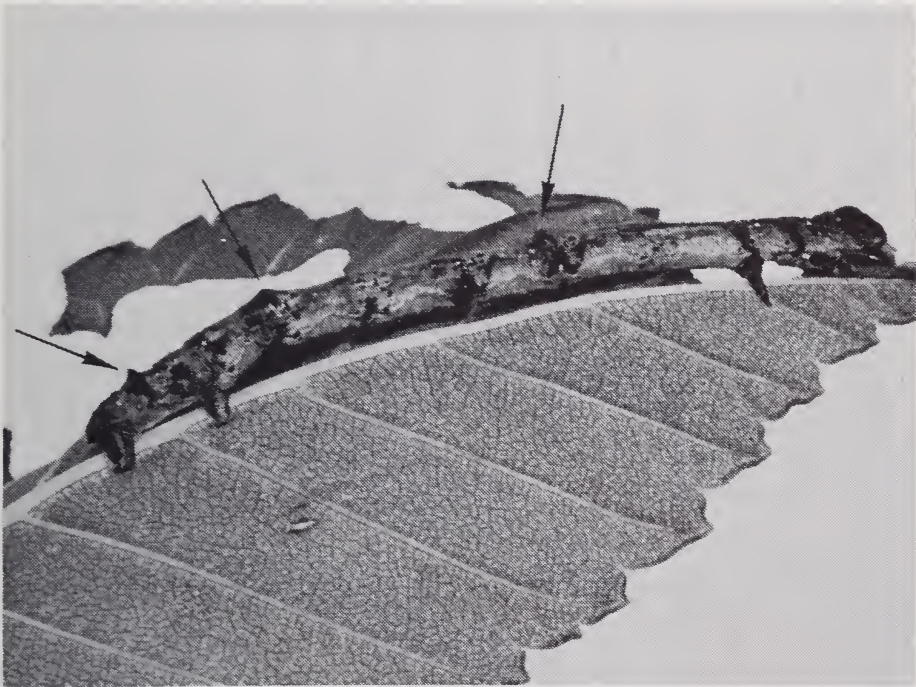


Figure 51.—Elm spanworm (*Ennomos subsignarius*) feeding on American elm (note transverse ridge on abdominal segments 2, 5, and 8).

- 81(80). Body mottled brown, abdominal segments 2 and 3 with a pair of white tipped filaments. American elm, Siberian elm. Larvae present from June to July. *Nematocampa limbata* (Haworth) filament bearer
- 81'. Body reddish brown and covered with coarse rugosities, abdominal segments 2 to 4 with winged lateral projections. American elm, Siberian elm. Larvae present from July to August. *Nemoria* sp.
 a winged looper

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, F = leafrollers, R = leafrollers, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Acrobasis</i> sp. (a leafrolling moth)				R							
<i>Acronicta americana</i> (American dagger moth)			S	S		S	S				
<i>Acronicta dactylina</i> (a dagger moth)					S						S
<i>Acronicta leporina vulpina</i> (a dagger moth)				S		S					S
<i>Acronicta lepusculina</i> (cottonwood dagger moth)						S					S
<i>Actias luna</i> (luna moth)	S								S		S
<i>Alsophila pometaria</i> (fall cankerworm)	S	S	S		S	S	S		S		
<i>Altica plicipennis</i> (a chrysomelid leaf beetle)					S						S
<i>Antheraea polyphemus</i> (polyphemus moth)	S								S		S
<i>Archips argyrospilus</i> (fruittree leafroller)							F				
<i>Archips cerasivoranus</i> (uglynest caterpillar)					W						
<i>Biston cognataria</i> (pepper-and-salt moth)			S								S
<i>Caliroa cerasi</i> (pearslug)		C									

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, R = leafrollers, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cottonwood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Cadroa</i> sp. (a slug sawfly)				C							
<i>Canarsia ubinairosorella</i> (a leaf tying moth)	W										
<i>Cecidomyia</i> sp. (a leaf folding fly)				F							
<i>Ceratonia amyntor</i> (elm sphinx)	S						S		S		
<i>Cerura scolopendrina</i> (a twotailed caterpillar)									S		
<i>Chrysomela scripta</i> (cottonwood leaf beetle)						S					S
<i>Cimbex americana</i> (elm sawfly)	S								S		S
<i>Cotalpa lanigera</i> (goldsmith beetle)						S		S			S
<i>Datana ministra</i> (yellownecked caterpillar)	C			C							C
<i>Diapheromera femorata</i> (walkingstick)				S							
<i>Dichelonyx subvittata</i> (a June beetle)	S			S	S		S		S		S
<i>Diprion similis</i> (introduced pine sawfly)								S			
<i>Disonychia alternata</i> (a chrysomelid leaf beetle)											S

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, F = leafrollers, R = leaffolders, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Entomoma subsignarius</i> (elm spanworm)	S								S		
<i>Epicauta fabricei</i> (ashgray blister beetle)										S	
<i>Epicauta subglabra</i> (caragana blister beetle)										S	
<i>Erannia tilitaria</i> (linden looper)	S								S		
<i>Halisidota maculata</i> (spotted tussock moth)			S		S		S				S
<i>Halisidota tessellaris</i> (pale tussock moth)	S		S	S	S		S				
<i>Heterocampa guttivitta</i> (saddled prominent)	S				S				S		S
<i>Heterocampa manto</i> (variable oakleaf caterpillar)	S			S					S		
<i>Hyalophora cecropia</i> (cecropia moth)			S		S		S				S
<i>Hyphantria cunea</i> (fall webworm)	W	W			W	W				W	W
<i>Ionida</i> sp. (a leaf-folding fly)				F							
<i>Lepyrus palustris</i> (a weevil)	S								S		
<i>Limenitis archippus</i> (viceroys)						S					S

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, F = leafrollers, R = leafrollers, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Lytta nuttalli</i> (Nuttall blister beetle)										S	
<i>Magdalis arnicollis</i> (red elm bark weevil)	S								S		
<i>Magdalis barbata</i> (black elm bark weevil)	S								S		
<i>Malacosoma americanum</i> (eastern tent caterpillar)					W						
<i>Malacosoma californicum lutescens</i> (prairie tent caterpillar)					W		W				
<i>Malacosoma disstria</i> (forest tent caterpillar)				C	C						
<i>Melanoplus bivittatus</i> (two-striped grasshopper)	S	S	S							S	
<i>Melanoplus femurrubrum</i> (red-legged grasshopper)	S	S		S					S	S	
<i>Melanoplus sanguinipes</i> (migratory grasshopper)	S	S							S	S	
<i>Nematocampa limbata</i> (filament bearer)	S								S		
<i>Nematus mendicus</i> (a willow sawfly)											S
<i>Nematus ventralis</i> (willow sawfly)						S					S
<i>Nerice bidentata</i> (serrated elm caterpillar)	S										S

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, F = leafrollers, R = leaffolders, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Neotoma inconspicua</i> (plum web-spinning sawfly)		W									
<i>Nymphalis antiopa</i> (mourningcloak butterfly)	C								C		C
<i>Palaearctia uernata</i> (spring cankerworm)	S	S	S				S		S		
<i>Phyllocolpa bozemani</i> (poplar leaf-folding sawfly)						F					
<i>Polygonia interrogatoris</i> (violet tip caterpillar)	S								S		
<i>Polyphylia decemlineata</i> (ten-lined June beetle)											S
<i>Polyphylia hammondi</i> (a June beetle)											S
<i>Psorosina hammondi</i> (appleleaf skeletonizer)	R										
<i>Pyrithalia luteola</i> (elm leaf beetle)	S								S		
<i>Schizura ipomoeae</i> (false unicorn caterpillar)			S								S
<i>Schizura unicornis</i> (unicorn caterpillar)	S				S				S		S
<i>Sphinx chersis</i> (great ash sphinx)							S				
<i>Sphinx drupiferarum</i> (hackberry sphinx)		S			S						

INSECT DEFOLIATORS, BY FEEDING CHARACTERISTICS

C = gregarious or colonial defoliators, F = leaffolders, R = leafrollers, S = solitary defoliators, W = webworms

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
<i>Symmerista albicosta</i> (a redhumped oakworm)				C							
<i>Symmerista albifrons</i> (redhumped oakworm)				C							
<i>Symmerista canicosta</i> (redhumped oakworm)				C							
<i>Tethida cordigera</i> (blackheaded ash sawfly)							C				
<i>Tolyte velleda</i> (Velleda lappet moth)	S			S			S				S

SECTION II. GALL-MAKING INSECTS AND MITES

Galls appear as abnormal woody growths or swellings on twigs and branches, closed leaf galls, warty eruptions on the leaf blade, rosette-type leaf clusters, or abnormal fruit development.

1.	Damage on deciduous trees and shrubs	2
1'.	Damage on spruce. Galls on twig tips. June. <i>Adelges abietis</i> (L.)	eastern spruce gall aphid
2(1).	Damage on:	
	Willow	3
	Hackberry	9
	Green ash	12
	Boxelder, silver maple	16
	Elm	21
	Cottonwood	24
	American plum	29
	Common chokecherry	30
	Bur oak	31
	Rose	38
3(2).	Leaf galls	4
3'.	Twig and branch galls	7
4(3).	Leaves stunted	5
4'.	Leaves not stunted	6
5(4).	Terminal growth with one pine conelike gall (fig. 52). Willow. Summer. <i>Rhabdophaga strobiloides</i> (Osten Sacken)	pine cone gall
5'.	Terminal growth with 2 to 5 pine conelike galls. Willow. Summer. <i>Rhabdophaga racemi</i> Felt	clustered willow gall

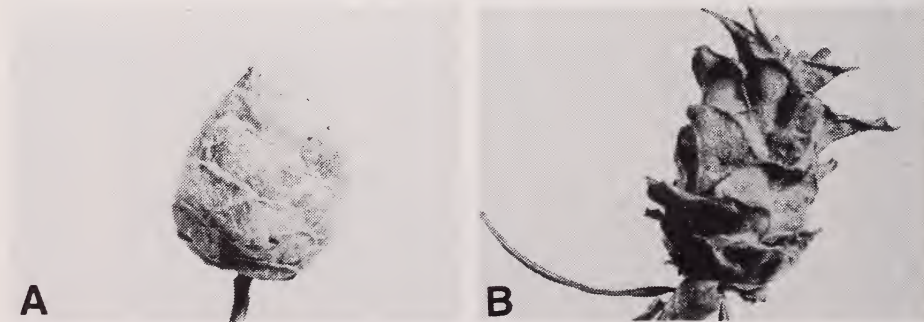


Figure 52.—Pine cone gall (*Rhabdophaga strobiloides*): A, gall on *Salix alba* (length 25-40 mm); B, gall on *Salix* sp.

- 6(4). Smooth spherical gall, yellow with red tinge (fig. 53).
 Willow. June to October. *Pontania hospes* (Walsh)
 willow apple gall
- 6'. Rough flat-ovoid gall, yellowish green to red (fig. 54).
 Willow. June to October. *Pontania proxima* (Lepeletier)
 bean gall sawfly

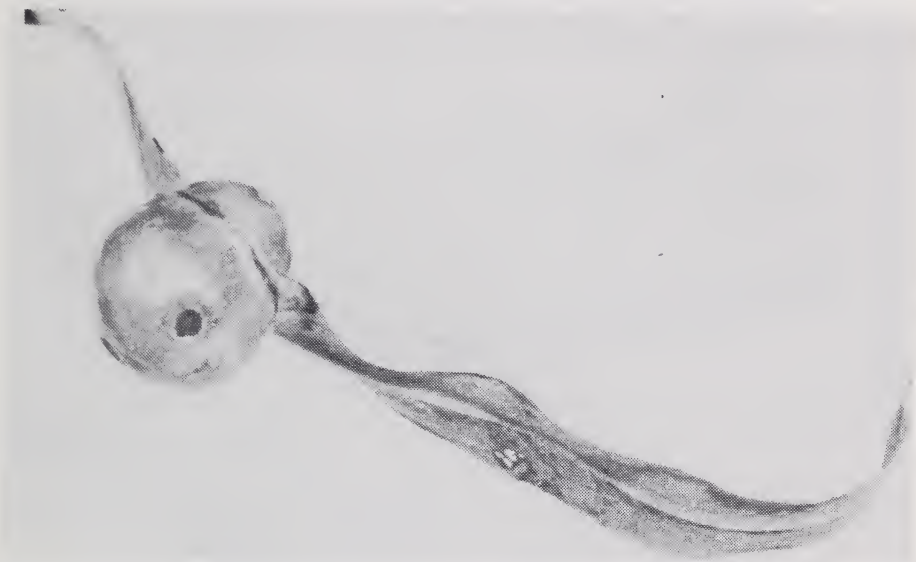


Figure 53.—Willow apple gall (*Pontania hospes*) on *Salix* sp. (diameter 8-12 mm). This gall is synonymous with *P. pomum*.

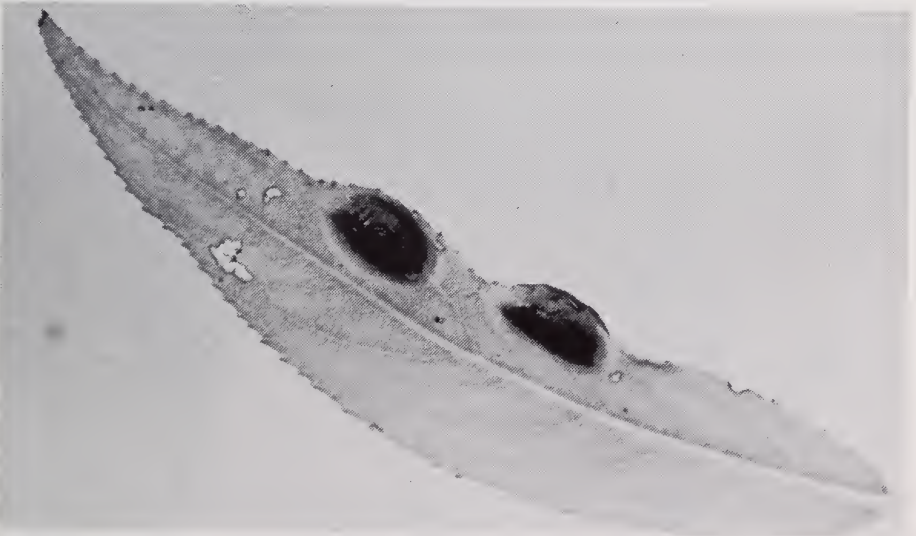


Figure 54.—Bean gall sawfly (*Pontania proxima*) on willow. This species has two or more generations per year.

- 7(3). Gall on current season's growth8
 7'. Gall not on current season's growth. Gall with diameter of 2 inches or less and encircling the branch. Serpentine tunnels packed with granular frass, exit hole at bottom edge of gall. Branch dies. Willow. Adults (fig. 55) present in June.
Agrilus politus (Say)a flatheaded wood borer
Agrilus criddlei Frosta flatheaded wood borer

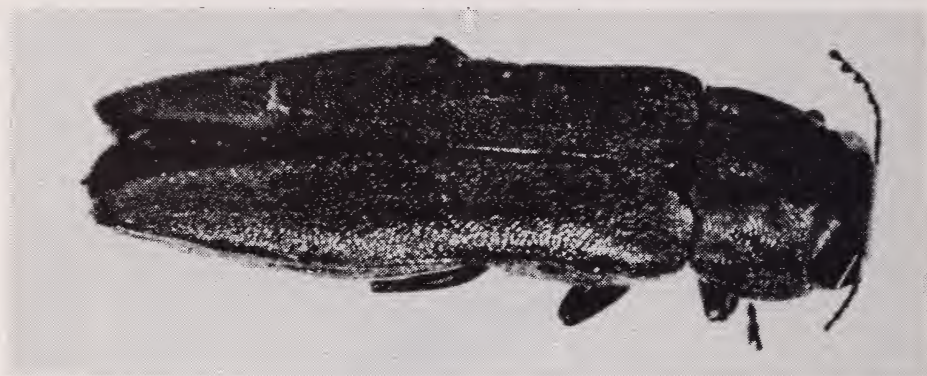


Figure 55.—A flatheaded willow borer (*Agrilus criddlei*).

- 8(7). Single larval chamber, narrowly oval gall. Terminal twig beyond gall dies and forms a beak (fig. 56). Willow. Summer. *Mayetiola rigidae* (Osten Sacken)
 willowbeaked gall midge
 8'. Multiple larval chambers, potato type gall (fig. 57). Willow. Summer. *Euura* sp.a sawfly twig gall

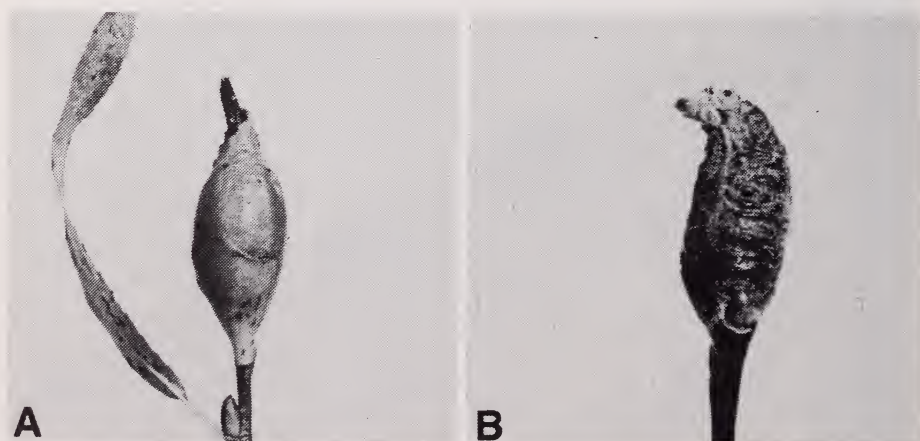


Figure 56.—Willowbeaked gall midge (*Mayetiola rigidae*): A, gall on *Salix alba*; B, gall on *Salix* sp.



Figure 57.—*Euura* sp. on willow twig.

- | | | |
|--------|--|----|
| 9(2). | Leaf gall | 10 |
| 9'. | Terminal bud slightly enlarged, 2 to 3 larval chambers.
Hackberry. Summer. <i>Pachypsylla gemma</i> Riley
..... hackberry bud gall | |
| 10(9). | Gall on leaf blade | 11 |
| 10'. | Gall on midvein, light tan to dark brown, kidney
shaped (fig. 58). Hackberry. Summer. <i>Pachypsylla</i>
<i>venusta</i> Osten Sacken hackberry petiolegall | |



Figure 58.—Hackberry petiolegall (*Pachypsylla venusta*), length 10-20 mm.

- 11(10). Yellow blister gall on upper leaf surface, small blunt point in the center, irregular to circular in outline. Hackberry. Summer. *Pachypsylla celtidisvesicula* Riley
 hackberry blister gall
- 11'. Light green mammiform gall on lower leaf surface (fig. 59). Cup-shaped depressions on upper leaf surface. Hackberry. Summer. *Pachypsylla celtidismamma* (Riley)hackberry nipplegall maker



Figure 59.—Hackberry nipplegall maker (*Pachypsylla celtidis-mamma*), length 8 mm.

12(2).	Found on buds and leaves13
12'.	Found on staminate flowers; distorted lobulate galls which may or may not be produced on stalks (fig. 60). Green ash. Spring. <i>Eriophyes fraxiniflora</i> Felt	
	ash flower gall mite



Figure 60.—Ash flower gall mite (*Eriophyes fraxiniflora*): A, showing the difference between normal male flowers (1) and those attacked by mites (2); B, galls on flower stalks; C, leaves attacked by mites.



Figure 60C.—Leaves attacked by mites.

- | | | |
|---------|--|-----------------|
| 13(12). | Found on the midvein | 14 |
| 13'. | Found on the leaf blade | 15 |
| 14(13). | Spherical gall on upper surface (fig. 61). One larva per gall. Green ash. June to September. <i>Cecidomyia pellex</i> Osten Sacken | ash bullet gall |
| 14'. | Pouch-type midrib gall with exit on upper leaf surface (fig. 62). Numerous larvae per gall. Green ash. Early summer. <i>Contarinia canadensis</i> Felt . . . | ash midrib gall |



Figure 61.—Ash bullet gall (*Cecidomyia pellex*) on midvein of green ash.



Figure 62.—Ash midrib gall (*Contarinia canadensis*).

- 15(13). Beadtype gall (fig. 63) that protrudes from both surfaces of the leaf blade. Green ash. Summer. *Aceria chondriphora* Keifer a beadtype gall mite
- 15'. Distorted and tightly rolled leaves 2 to 3 inches in diameter (fig. 60), unstalked lobulate galls. Green ash. Summer. *Eriophyes fraxiniflora* Felt
..... ash flower gall mite



Figure 63.—*Aceria chondriphora* on the leaf blade of green ash.

- 16(2). Leafgall17
- 16'. Twiggall, gradual swelling with entrance hole in bottom half (fig.64). Boxelder. May to July. *Proteoteras willingana* (Kearfott) boxelder twig borer



Figure 64.—Boxelder twig borer (*Proteoteras willingana*): A, mature gall with entrance hole on the right (length 20-40 mm), previous year's gall on the left; B, fresh attack with exposed frass.

17(16).	Found on boxelder	18
17'.	Found on silver maple	20
18 (17).	Galls on upper leaf surface	19
18'.	Midrib gall on lower leaf surface. Enlarged pouch-type gall with exit on upper leaf surface (fig. 65). Numerous maggots per gall. Boxelder. June to August. <i>Dasineura communis</i> Felt	gouty vein gall



Figure 65.—Gouty vein gall (*Dasineura communis*) on boxelder (length 10-25 mm).

- 19(18). Hemispherical galls on midvein (fig. 66), light green with bluish tint. Boxelder. June to September. *Contarinia negundifolia* Felt boxelder leafgall
- 19'. Warty swellings on leaf surface (fig. 67), white or brown leaf pile (hair) underneath. Boxelder. Summer. *Aceria negundi* Hodgkiss warty leafgall



Figure 66.—Boxelder leafgall (*Contarinia negundifolia*), diameter 2 mm, height 3-5 mm.



Figure 67.—Warty leafgall (*Aceria negundi*) on boxelder (diameter 3-5 mm).

- 20(17). Warty swellings on upper leaf surface (fig. 68), red or green. Silver maple. Summer. *Vasates quadripedes* (Shimer) maple bladdergall mite
- 20'. Pile (hair) on upper leaf surface, pink. Silver maple. Summer. *Aceria* sp a bladdergall mite



Figure 68.—Maple bladdergall mite (*Vasates quadripedes*).

21(2).	Found on American elm	22
21'.	Found on Siberian elm. Spindle-shaped gall on upper leaf surface, light green. Summer. <i>Aceria</i> sp	a finger gall mite
22(21).	Leafgall	23
22'.	Twiggal, knotty growth. American elm. Summer. <i>Eriosoma rileyi</i> (Thomas)	woolly elm bark aphid
23(22).	Coxcomb-shaped ridges between veins on upper leaf surface. Green aphids with brown or black legs. American elm. June to July. <i>Colopha ulmicola</i> (Fitch)	elm cockscomb gall aphid
23'.	Spindle-shaped gall on upper leaf surface (fig. 69). American elm. Summer. <i>Aceria ulmicola</i> (Nalepa)	elm leaf gall



Figure 69.—Elm leafgall (*Aceria ulmicola*) on American elm.

24(2).	Leafgall	25
24'.	Bud or twiggal	27
25(24).	Damage on petiole	26
25'.	Damage on leaf blade. Fleshy convoluted leaves (fig. 70). Aphids are green with dusky gray head and legs. Cottonwood. May to July. <i>Mordwilkoja vagabunda</i> (Walsh)	poplar vagabond aphid



Figure 70.—Poplar vagabond aphid (*Mordwilkoja vagabunda*).

- 26(25). Round gall formed by petiole only, transverse exit slit (fig. 71). Cottonwood. June to September. *Pemphigus populitransversus* Riley **poplar petiolegall aphid**
- 26'. Round gall formed by swelling and twisting of the petiole and leaf blade, angular exit slit (fig. 72). Cottonwood. June to September. *Pemphigus populi-caulis* Fitch **poplar leaf-petiolegall aphid**



Figure 71.—Poplar petiolegall aphid (*Pemphigus populitransversus*) on cottonwood; diameter 12-19 mm with a transverse exit slit.



Figure 72.—Poplar leaf-petiolegall aphid (*Pemphigus populi-caulis*). Gall diameter is 10-13 mm with a twisted angular exit slit.

- 27(24). Twig gall28
- 27'. Blasted enlarged buds, minute aborted leaves (fig. 73).
Cottonwood. May to July. *Aceria parapopuli* Keifer
..... poplar bud gall mite



Figure 73.—Poplar bud gall mite (*Aceria parapopuli*).

- 28(27). Round gall formed on current twig growth (fig. 74) or
base of petiole, transverse exit slit. Cottonwood. June
to August. *Pemphigus populiramulorum* Riley
..... poplar twiggall aphid
- 28'. Oval or oblong gall on current twig growth, round exit
hole (fig. 75). Cottonwood, aspen. Summer. *Melanagromyza schineri* (Giraud) poplar twiggall fly

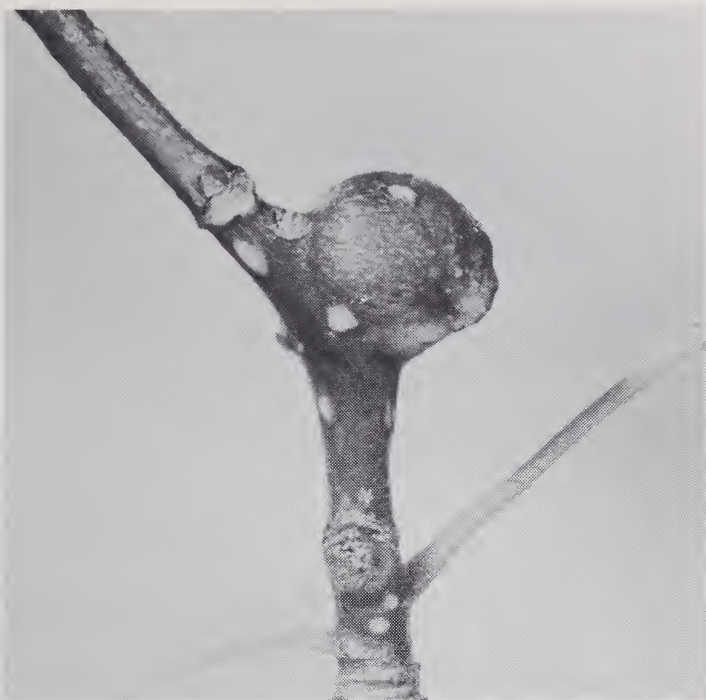


Figure 74.—Poplar twiggall aphid (*Pemphigus populiramulorum*).

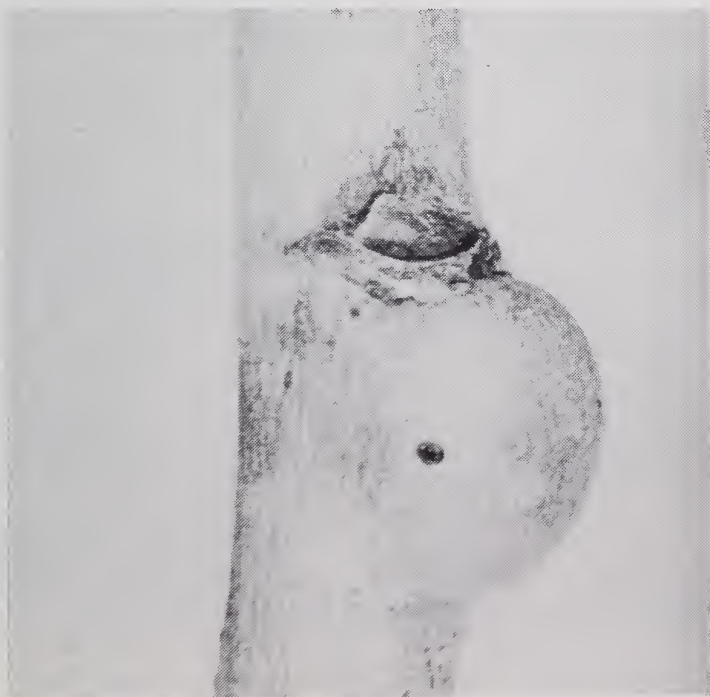


Figure 75.—Poplar twiggall fly (*Melanagromyza schineri*).

- 29(2). Spindle-shaped gall on upper leaf surface (fig. 76), red to light green. American plum, common chokecherry. Summer. *Eriophyes emarginate* Keifer
 a finger gall mite
- 29'. Spindle-shaped gall on lower leaf surface (fig. 77), light green. American plum. Summer. *Eriophyes cerasi-crumena* Walsha finger gall mite



Figure 76.—*Eriophyes emarginate* on plum; diameter 2 mm, length 5-8 mm.



Figure 77.—*Eriophyes cerasi-crumena* on plum; diameter 2 mm, length 8-13 mm.

- 30(2). Spindle-shaped gall on upper leaf surface (fig. 76). Common chokecherry, American plum. Summer. *Eriophyes emarginate* Keifera finger gall mite
- 30'. Fleshy and enlarged fruit (fig. 78), abortive seed, orange maggots present until fruit drops. Common chokecherry. May to September. *Contarinia virginianiae* (Felt)chokecherry midge



Figure 78.—Chokecherry midge (*Contarinia virginianiae*) causes premature dropping of fruit.

31(2).	Leaf gall	32
31'.	Twig gall. Light tan globular woody gall with a rough surface, found in groups of 3 or more (fig. 79). Bur oak. Summer. <i>Disholcaspis quercusmamma</i> (Walsh)	oak bullet gall
32(30).	Rosette-type gall	33
32'.	Woolly, spherical, or blister-type gall	34



Figure 79.—Oak bullet gall (*Disholcaspis quercusmamma*) on bur oak. Freshly emerged female on gall.

- 33(31). Distorted rosette-type leaves less than $\frac{1}{2}$ inch in length, 1 to 3 larval chambers present. Bur oak. Spring and summer. *Cynips* sp. an oak rosette gall
- 33'. Circular arrangement of rosette leaflets on midvein, 1 to 5 larval chambers present. Bur oak. Early summer. *Andricus foliosus* Weld June gall wasp
- 34(31). Gall attached to leaf blade or veins 35
- 34'. Globose gall broadly attached to the petiole or midrib at base of leaf (fig. 80), smooth, multiple larval chambers. Bur oak. Summer. *Andricus petiolicola* (Osten Sacken) oak petiolegall



Figure 80.—Oak petiolegall (*Andricus petiolicola*). This gall can also be located on the midrib.

- 35(33). Galls on lower leaf surface36
 35'. Galls on upper leaf surface. Blister-type galls vary from yellow to red with brown pile (hair) inside opening on lower leaf surface (fig. 81). Bur oak. Summer. *Aceria querci* (Garman) a blister gall mite



Figure 81.—A blister gall mite (*Aceria querci*) on bur oak.

- 36(35). Woody gall has facets with or without spines37
36'. Dense woolly gall has white or red pile (fig. 82a).
Attached to the vein. Larval cells resemble kernels (fig.
82b). Bur oak. Summer and fall. *Andricus ignotus*
(Bassett) woolly oak gall

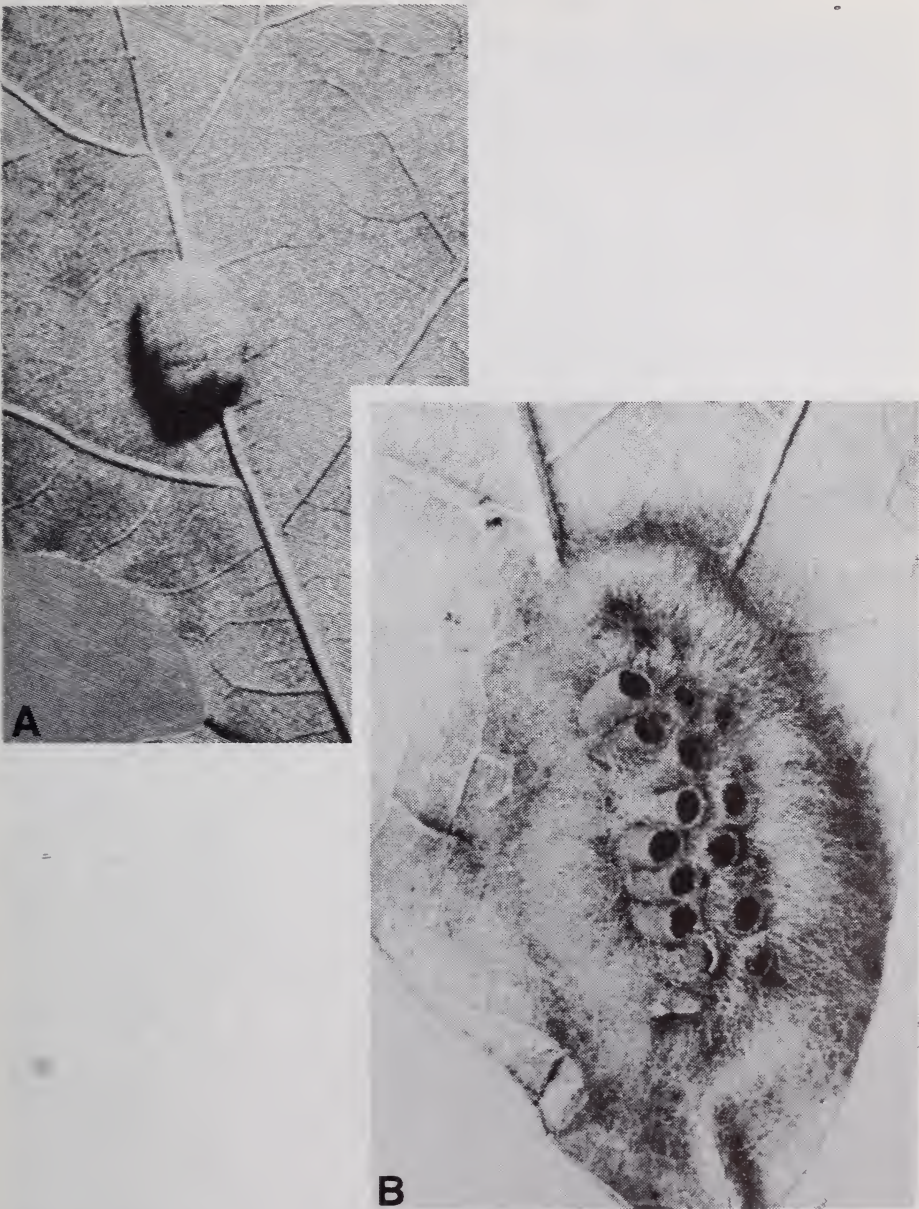


Figure 82.—Woolly oak gall (*Andricus ignotus*): A, woolly hair covering several kernel shaped larval cells; B, larval cells exposed showing exit holes.

- 37(36). Gall light brown. Crisscrossed cracks resulting in spineless facets (fig. 83). Bur oak. Summer. *Acraspis macrocarpae* Bassett jewel oak gall
- 37'. Gall light tan. Crisscrossed fissures resulting in conelike projections with spines (fig. 84). Bur oak. Summer. *Acraspis villosa* Gillette hairy oak gall



Figure 83.—Jewel oak gall (*Acraspis macrocarpae*).

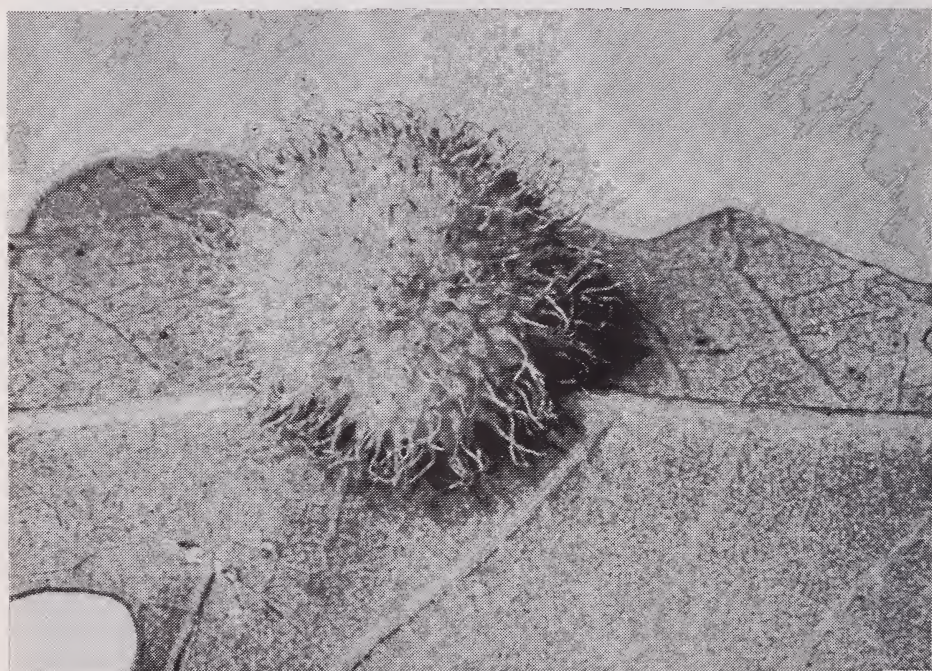


Figure 84.—Hairy oak gall (*Acraspis villosa*).

- 38(2). Leaf gall39
- 38'. Stem gall, green to reddish brown with sparse short
 spines. Numerous larval chambers. Rose. Summer.
Diplolepis spinosa (Ashmead) rose twiggall
- 39(37). Spiked gall, yellow with red tinge, on lower leaf
 surface. Rose. Summer. *Diplolepis bicolor* (Harris)
 spiny rose gall
- 39'. Pine conelike gall on terminal growth (fig. 85). Rose.
 Summer and fall. *Rhabdophaga rosacea* Felt
 rosette midge



Figure 85.—Rosette midge (*Rhabdophaga rosacea*).

INSECT AND MITE GALLS, BY POINT OF ATTACK

B = buds, L = leaves, T = twigs

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	White willow	Hackberry
<i>Aceria chondriphora</i> (a beadtape gall mite)							L		
<i>Aceria negundi</i> (warty leafgall)			L						
<i>Aceria parapopuli</i> (poplar bud gall mite)						B			
<i>Aceria quercia</i> (a blister gall mite)				L					
<i>Acraspis macrocarpae</i> (jewel oak gall)				L					
<i>Acraspis villosa</i> (hairy oak gall)				L					
<i>Andricus foliosus</i> (June gall wasp)				L					
<i>Andricus ignotus</i> (woolly oak gall)				L					
<i>Andricus petiolicola</i> (oak petiolegall)				L					
<i>Cecidomyia pellex</i> (ash bullet gall)							L		
<i>Colopha ulmicola</i> (elm cockscombgall aphid)	L								
<i>Contarinia canadensis</i> (ash midrib gall)							L		

INSECT AND MITE GALLS, BY POINT OF ATTACK

B = buds, L = leaves, T = twigs

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	White willow	Hackberry
<i>Contarinia negundifolia</i> (boxelder leafgall)			L						
<i>Cynips</i> sp. (an oak rosette gall)				B					
<i>Dasineura communis</i> (gouty vein gall)			L						
<i>Disholcaspis quercusmamma</i> (oak bullet gall)				T					
<i>Eriophyes cerasi-crumena</i> (a finger gall mite)		L							
<i>Eriophyes emarginate</i> (a finger gall mite)		L			L				
<i>Eriophyes fraxiniflora</i> (ash flower gall mite)							B		
<i>Eriosoma rileyi</i> (woolly elm bark aphid)	T								
<i>Euura</i> sp. (a sawfly twiggall)								T	
<i>Mayetiola rigidulae</i> (willo wbeaked gall midge)								T	
<i>Melanagromyza schineri</i> (poplar twiggall fly)						T			
<i>Mordwilkoja vagabunda</i> (poplar vagabond aphid)						L			

INSECT AND MITE GALLS, BY POINT OF ATTACK

B = buds, L = leaves, T = twigs

Insect	American elm	American plum	Boxelder	Bur oak	Choke-cherry	Cotton-wood	Green ash	White willow	Hackberry
<i>Pachypsylla celtidis mamma</i> (hackberry nipplegall maker)									L
<i>Pachypsylla celtidis vesicula</i> (hackberry blister gall)									L
<i>Pachypsylla gemma</i> (hackberry bud gall)									B
<i>Pachypsylla venusta</i> (hackberry petiolegall)									L
<i>Pemphigus populicaulis</i> (poplar leaf-petiolegall aphid)						L			
<i>Pemphigus populiramulorum</i> (poplar twiggall aphid)						T			
<i>Pemphigus populitransversus</i> (poplar petiolegall aphid)						L			
<i>Pontania hospes</i> (willow apple gall)								L	
<i>Pontania proxima</i> (bean gall sawfly)								L	
<i>Rhabdophaga strobiloides</i> (pine cone gall)								L	

Plate 1



Polyphemus moth
(*Antheraea polyphemus*)



Red-humped oakworm
(*Symmerista albifrons*)



Spring cankerworm
(*Paleacrita vernata*)

Plate 2

Blackheaded ash sawfly
(*Tethida cordigera*)



Larch sawfly
(*Pristiphora erichsonii*)



Pepper-and-salt moth
(*Biston cognataria*)



Plate 3



Spruce needle miner
(*Taniva albolineana*)



Two-year-cycle budworm
(*Choristoneura biennis*)



Pearslug
(*Caliroa cerasi*)

Plate 4

A twig aphid
(*Pterocomma* sp.)



Chokecherry aphid
(*Aphis cerasifoliae*)



Fall webworm
(*Hyphantria cunea*)





Ash borer
(*Podosesia syringae fraxini*)



Elm sphinx
(*Ceratomia amynton*)



A dagger moth
(*Acronicta dactylina*)



Western pine tip moth
(*Rhyacionia bushnelli*)



Forest tent caterpillar
(*Malacosoma disstria*)

Plate 6

Prairie tent caterpillar (*Malacosoma californicum lutescens*)





Linden looper (*Erannis tiliaria*)

Woolly apple aphid
(*Eriosoma lanigerum*)



Plate 7

Pine pitch-nodule maker
(*Petrova luculentana*)





Yellownecked caterpillar
(*Datana ministra*)



Yellowheaded spruce sawfly
(*Pikonema alaskensis*)

Plate 8

Carpenterworm (*Prionoxystus robiniae*)



SECTION III. BORING AND LEAF-MINING INSECTS

Insects feed internally on woody tissue, fruits, seeds, or leaves.

1.	Larvae mine leaves	2
1'.	Larvae bore into wood or fruit	17
2(1).	Feed in hardwood leaves	3
2'.	Feed in spruce, larch, or tamarack needles	14
3(2).	Larvae construct serpentine or linear mines	4
3'.	Larvae construct blotch mines	7
4(3).	Feed in bur oak or elm leaves	5
4'.	Feed in cottonwood or willow leaves	6
5(4).	Serpentine mine on upper leaf surface (fig. 86). Bur oak. Larvae present from August to September. <i>Agromyza</i> sp a serpentine leafminer	
5'.	Linear mine on upper leaf surface. Mine narrow and terminates in a blotch. American elm, Siberian elm. Larvae present from May to July. <i>Agromyza aristata</i> Malloch a leafmining fly	



Figure 86.—*Agromyza* sp. on bur oak.

- 6(4). Meandering mine on lower leaf surface. Frass arranged in a definite trail (fig. 87). Cottonwood, aspen. Larvae present from July to August. *Phyllocnistis populiella* (Chambers) aspen leafminer
- 6'. Serpentine mine on upper leaf surface. Willow. Larvae present during July. *Agromyza* sp. a serpentine leafminer

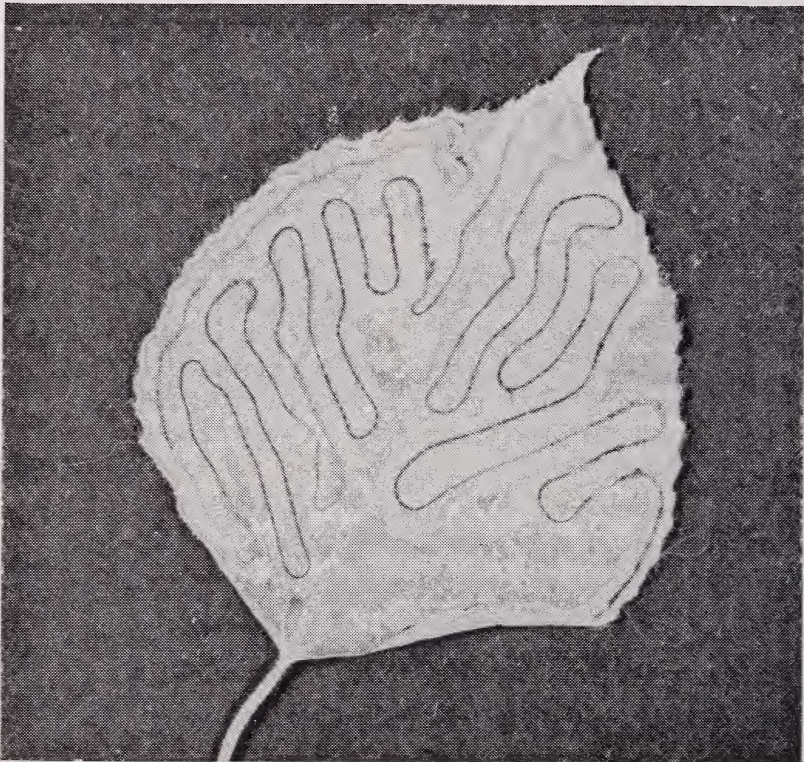


Figure 87.—Damage of aspen leafminer (*Phyllocnistis populiella*).

- 7(3). Head sclerotized8
- 7'. Head not sclerotized13
- 8(7). Larvae are solitary miners9
- 8'. Larvae are gregarious miners. Head and body depressed, pointed mouthparts. Bur oak. Larvae present from June to September. *Cameraria cincinnatiella* (Chambers) gregarious oak leafminer
- 9(8). Head rounded (fig. 89)10
- 9'. Head pointed (fig. 90a)11

- 10(9). Found on American elm. Mine parallel to leaf vein (fig. 88). Larvae present in June. *Fenusa ulmi* Sundevall
..... elm leafminer
- 10'. Found on cottonwood. Irregular blotch mine on upper leaf surface. Larvae (fig. 89) present from July to August. *Metallus capitalis* (Norton)
..... a leafmining sawfly



Figure 88.—Damage of elm leafminer (*Fenusa ulmi*) on American elm. (Photo courtesy Conn. Agr. Exp. Sta.).

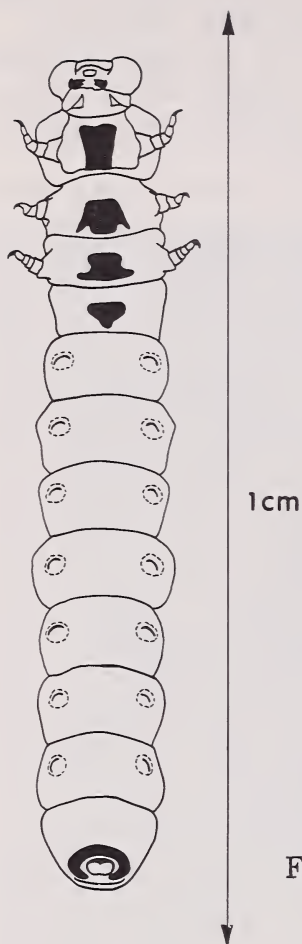


Figure 89.—*Metallus capitalis* (ventral view).

- 11(9). Found on bur oak12
 11'. Found on American elm. Blotch mine. Larvae present during July. *Cameraria* sp. a leafmining caterpillar
- 12(11). Larvae with prothorax (fig. 7) as wide as metathorax, head and body depressed, pointed mouthparts (fig. 90a). Body with dorsally sclerotized plates. Larvae feed in irregular blotch mine (fig. 90b). Bur oak. Larvae present from June to August. *Cameraria hamadryadella* (Clemens) solitary oak leafminer
- 12'. Larvae with prothorax wider than metathorax, body depressed and tapers caudally (fig. 91). Body without dorsally sclerotized plates. Larvae feed in irregular blotch mine. Bur oak. Larvae present during July. *Brachys aerosus* (Melsheimer) . . a leafmining buprestid

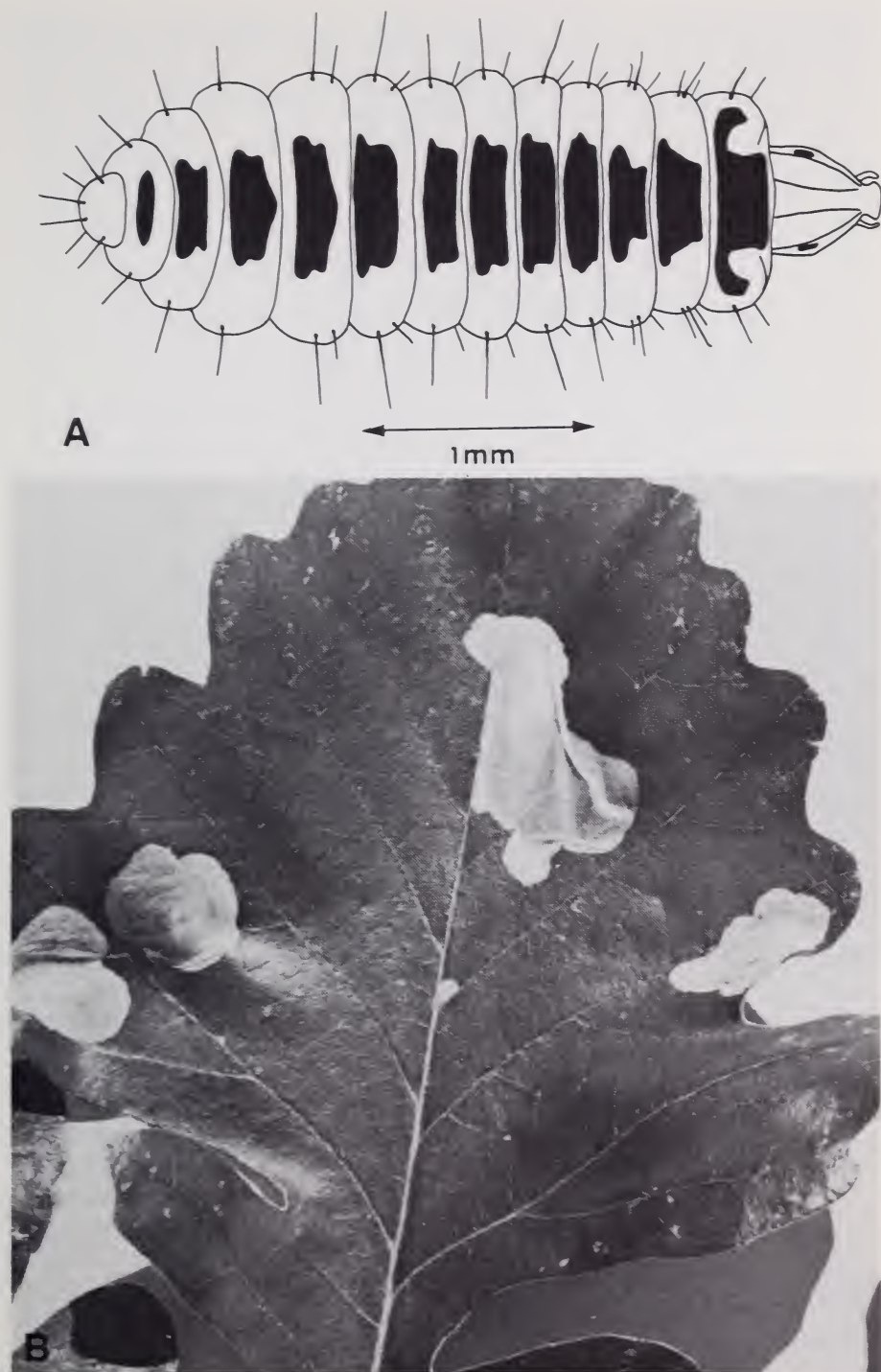


Figure 90.—Solitary oak leafminer (*Cameraria hamadryadella*):
A, larva; B, leaf mine on bur oak.

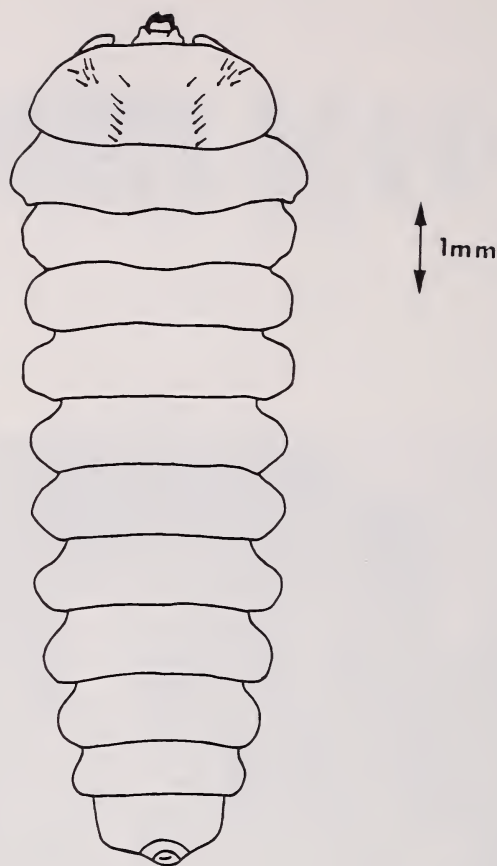


Figure 91.—*Brachys aerosus* (dorsal view).

- 13(7). Found on bur oak. Larvae feed in blotch mine on upper leaf surface from June to August. *Japana-gromyza viridula* (Coquillett) a leafmining fly
- 13'. Found on cottonwood. One or more larvae feed in dark irregular blotch mine from July to August. *Agromyza populoides* Spencer a leafmining fly
- 14(2). Spruce needles mined 15
- 14'. Larch needles mined, late summer and early spring. Larvae live within a case (fig. 92) which is attached to needles while feeding. Siberian larch, tamarack. Larvae present from July to June. *Coleophora laricella* (Hübner) larch casebearer

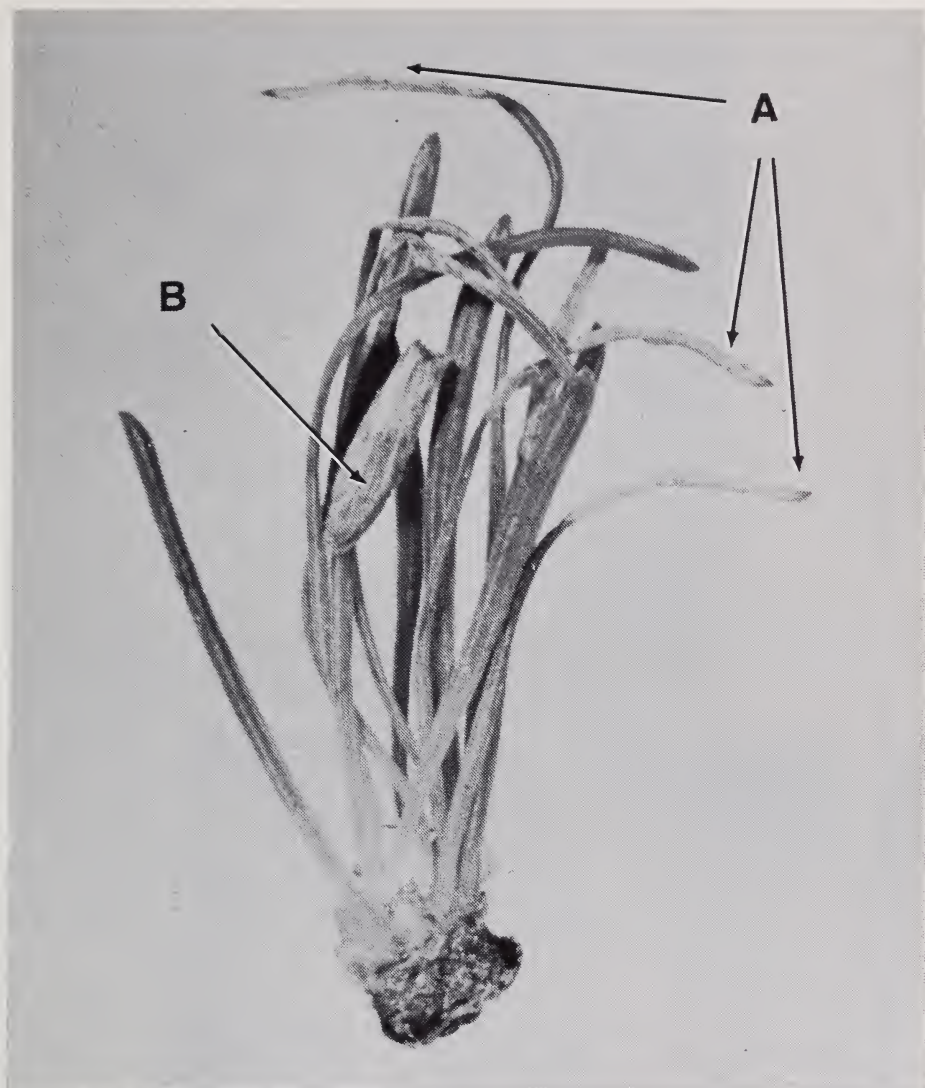


Figure 92.—Larch casebearer (*Coleophora laricella*): A, needle mining damage on Siberian larch; B, needle with case attached.

- 15(14). Frass absent from the mine16
 15'. Frass present in the mine, needles mined from base to apex. Loose webbing containing a silken tube surrounds the needles, accumulation of frass in webbing and tube (fig. 93). White spruce, blue spruce. Adults active from May to June. *Epinotia nanana* (Treitchke) a needlemining caterpillar

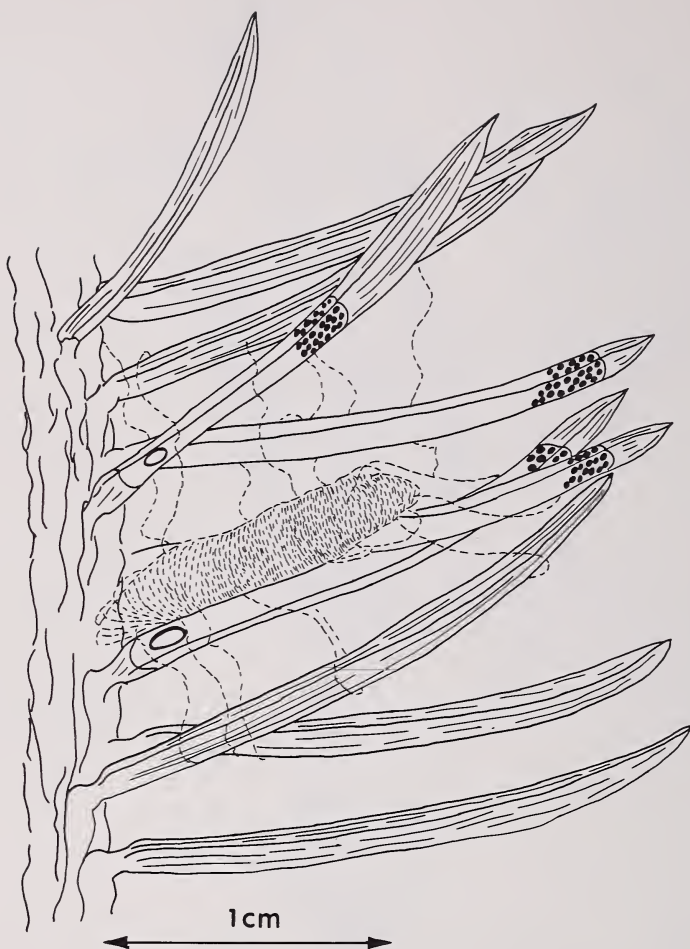


Figure 93.—Damage of *Epinotia nanana*.

- 16(15). Larvae densely web cut needles together. More than one larvae present, accumulation of frass in webbing (plate 3; fig. 94). Pupate in frass heap. White spruce, blue spruce. Adults active from June to July. *Taniva albolineana* (Kearfott) spruce needle miner
- 16'. Larvae loosely web uncut needles (fig. 95). Only one larva present, very little accumulation of frass in webbing. White spruce, blue spruce. Adults active from June to July. *Pulicalvaria piceaella* (Kearfott)
 a needle mining caterpillar



Figure 94.—Spruce needle miner (*Taniva albolineana*): A, webbed needles; B, needle mine entrance.

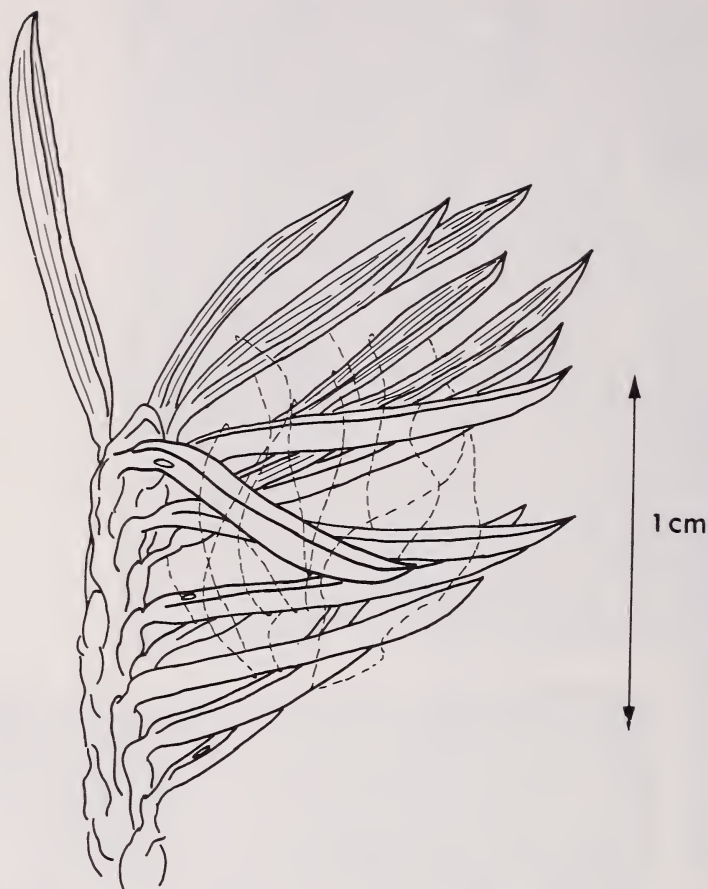


Figure 95.—Damage of *Pulicalvaria piceaella*.

- | | | |
|---------|--|------------------|
| 17(1). | Larvae feed in seed or in pine cones | 18 |
| 17'. | Larvae feed on roots, bore under bark or into wood..... | 23 |
| 18(17). | Found on hardwood trees | 19 |
| 18'. | Found on ponderosa pine. Caterpillars mine the bracts and seeds of pine cones (fig. 96). One or more larvae pupate in the cone. Larvae found from July to August. <i>Dioryctria auranticella</i> (Grote) | a pine cone moth |
| | <i>Dioryctria disclusa</i> Heinrich | a pine cone moth |



Figure 96.—Damage of *Dioryctria auranticella* to ponderosa pine cone.

- 19(18). Larvae infest seeds of Siberian peashrub or green ash 20
- 19'. Larvae infest plums or acorns 21
- 20(19). Found in green ash seeds. Grublike larvae present from July to the following May. *Thysanocnemis* nr. *fraxini* LeConte an ash seed weevil
- 20'. Found in Siberian peashrub seeds. Grublike larvae present from July to the following May. (fig. 97). *Bruchophagus caraganae* (Nikolskaya) caragana seed chalcid

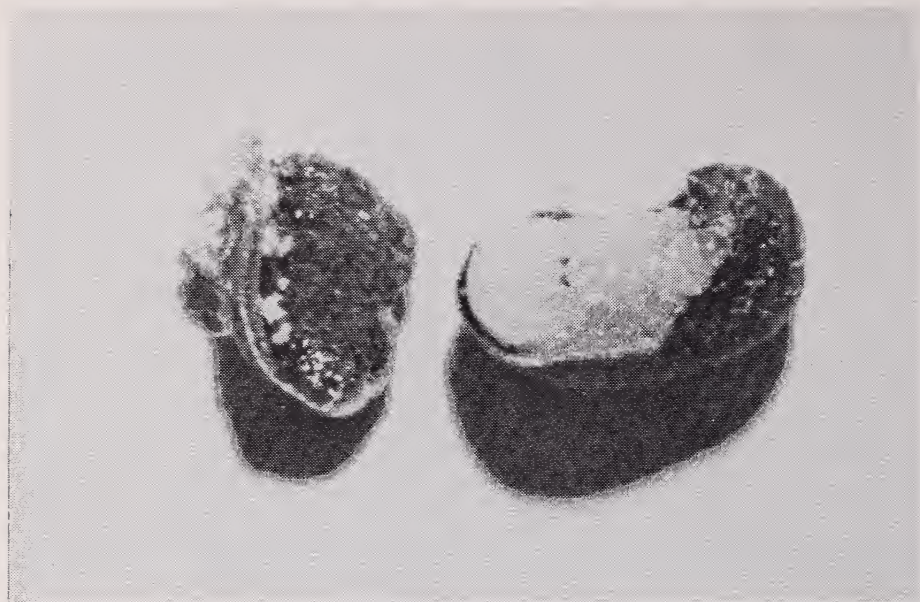


Figure 97.—Caragana seed chalcid (*Bruchophagus caraganae*).

- | | | |
|---------|---|---------------|
| 21(19). | Grublike larvae in plum fruit | 22 |
| 21'. | Grublike larvae in acorns, pupate in the soil. Bur oak.
Larvae present from July to August.
<i>Conotrachelus posticatus</i> Boheman . . . an acorn weevil
<i>Curculio strictus</i> (Casey) an acorn weevil
<i>Curculio iowensis</i> (Casey) an acorn weevil | |
| 22(21). | Larvae pupate in the pit. American plum. <i>Anthonomus</i>
<i>scutellaris</i> LeConte | plum gouger |
| 22'. | Larvae pupate in the soil, crescent-shaped egg punctures on fruit. American plum. <i>Conotrachelus</i>
<i>nenuphar</i> (Herbst) | plum curculio |
| 23(17). | Found in evergreen trees | 24 |
| 23'. | Found in hardwood trees | 35 |
| 24(23). | Larvae feed on live wood | 25 |
| 24'. | Larvae feed on dead wood | 29 |
| 25(24). | Larvae feed in buds, twigs, or branches | 26 |
| 25'. | Larvae feed on roots. Grublike larva C-shaped (fig. 98c) pupates in the soil (fig. 98a). White spruce, blue spruce. Adults (fig. 19) active during July. <i>Polyphylla</i>
<i>hammondi</i> LeConte | a June beetle |

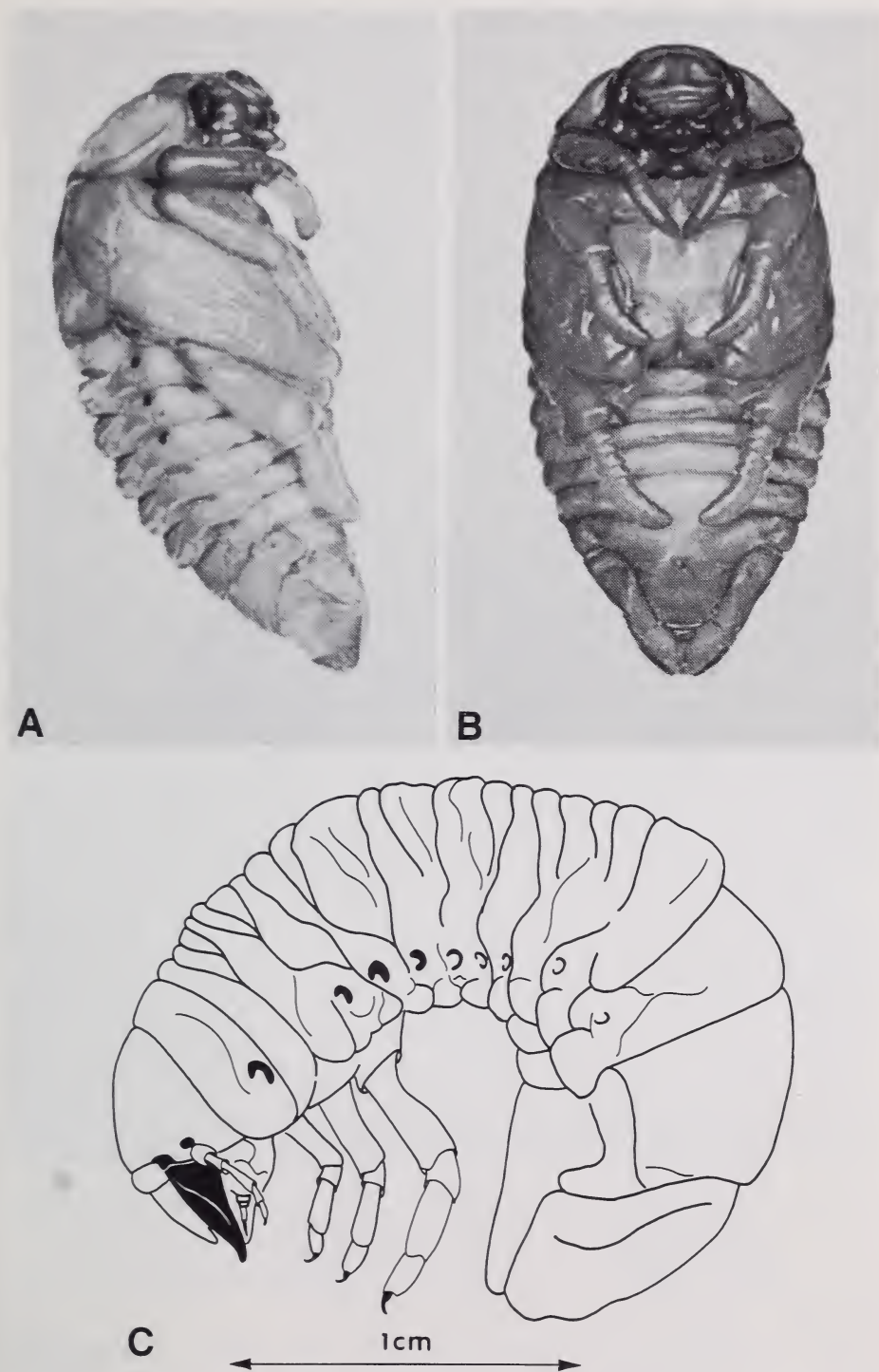


Figure 98.—*Polyphylla hammondi*: A, pupa (lateral view); B, pupa (ventral view); C, larva (lateral view).

- 26(25). Larvae infest terminal twigs27
 26'. Larvae infest terminal or lateral buds and bore into center of the twig (plate 6; fig. 99). Ponderosa pine, Austrian pine, Scotch pine. Larvae present from June to August. *Rhyacionia bushnelli* Busck
 western pine tip moth



Figure 99.—Needle mining stage of the western pine tip moth (*Rhyacionia bushnelli*).

- 27(26). Pitch nodule on twig or branch28
 27'. Wilted brown terminal (fig. 100), grublike larvae feed downward under bark and destroy 2 or more years of growth. White spruce, blue spruce. Larvae present from May to July. *Pissodes strobi* (Peck) . .white pine weevil

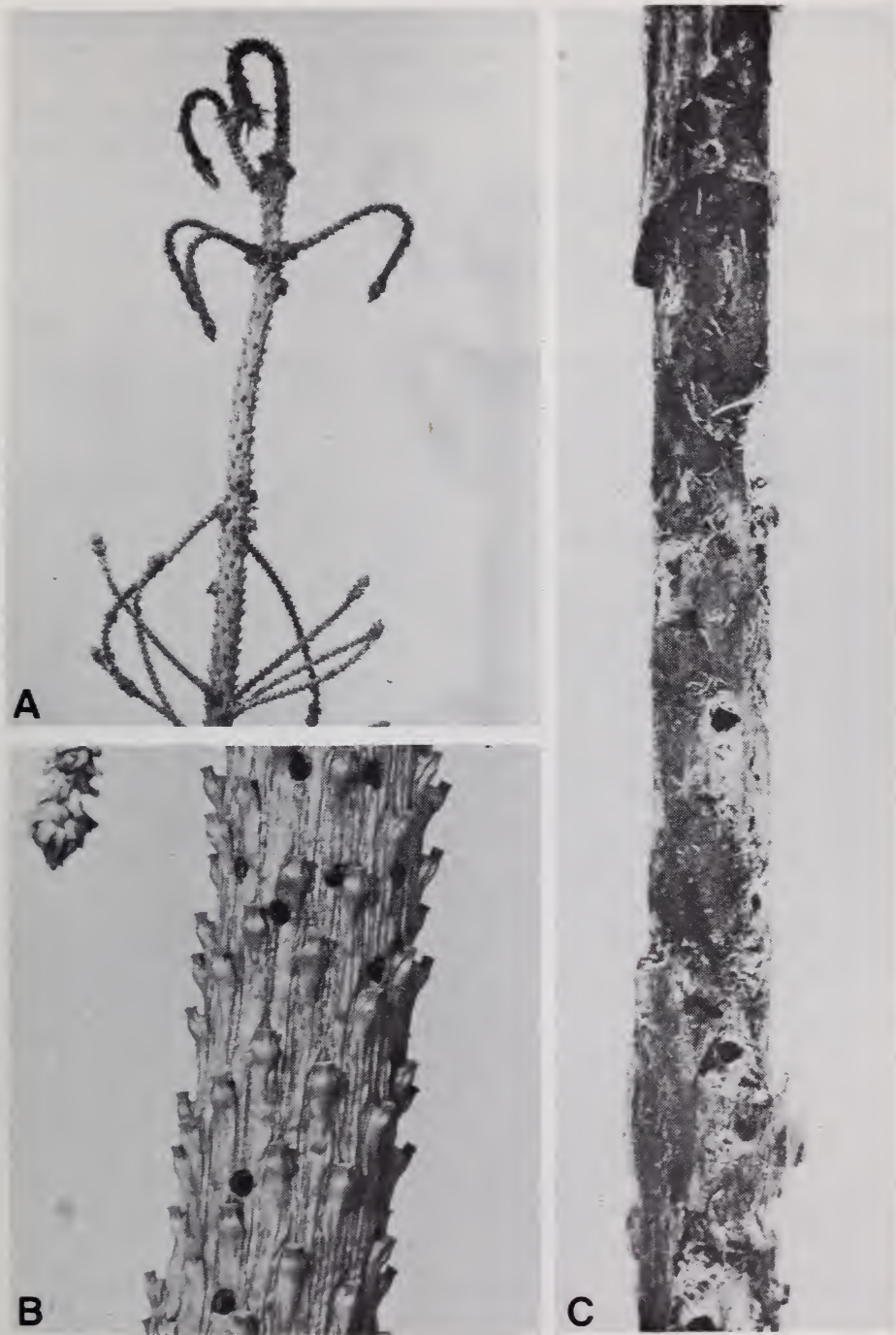


Figure 100.—White pine weevil (*Pissodes strobi*): A, dead spruce terminal; B, emergence holes; C, bark removed to expose chip cocoons associated with emergence holes.

- 28(27). Pitch blister $\frac{1}{4}$ inch in diameter (plate 7). Ponderosa pine, Scotch pine. Larvae present from June to August. *Petrova luculentana* (Heinrich)
 pine pitch-nodule maker
- 28'. Pitch mass $\frac{1}{2}$ inch or more in diameter (fig. 101). Austrian pine, Scotch pine, ponderosa pine. Larvae present from June to August. *Dioryctria zimmermani* (Grote) Zimmerman pine moth
Dioryctria tumicolella Mutuura & Munroe
 a pitch mass borer



Figure 101.—Pitch mass made by Zimmerman pine moth (*Dioryctria zimmermani*) on ponderosa pine.

- 29(24). Tunnel less than 3 inches long with numerous side branches (fig. 102)30
- 29'. Tunnel more than 3 inches long with no side branches 31

- 30(29). Adult beetles with toothed elytra (fig. 103a). Radial gallery associated with branch whorl (fig. 102), grub-like larvae infest medium to large branches. Ponderosa pine. *Orthotomicus caelatus* Eichhoff
..... a bark beetle
- 30'. Adult beetles with rounded elytra (fig. 103b). Radial gallery associated with branch whorl, grublike larvae infest medium to large branches in dying trees. Ponderosa pine. *Pityophthorus* prob. *inquietus* Blackman a bark beetle

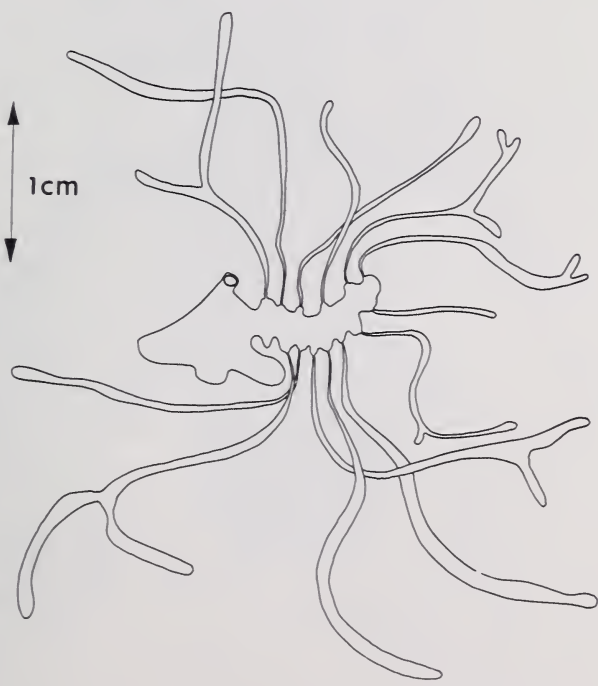
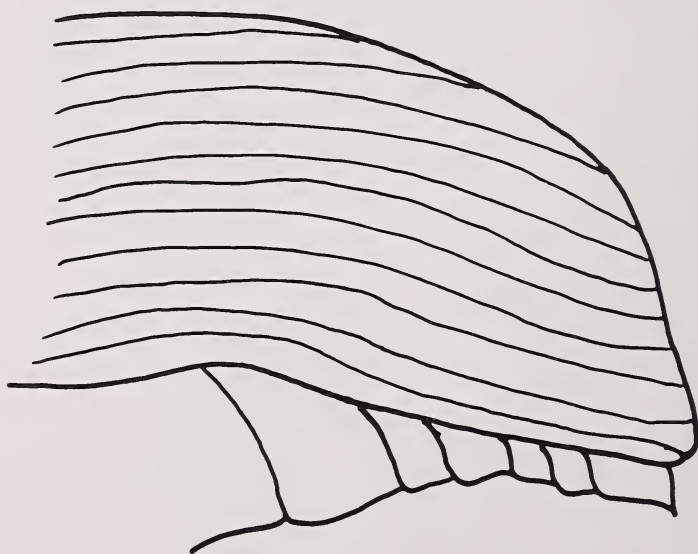


Figure 102.—Gallery of *Orthotomicus caelatus*.



1mm



1mm

Figure 103.—Examples of elytra: A, *Orthotomicus caelatus*; B, *Pityophthorus inquietus*.

- 31(29). Tunnel with tightly packed, granular frass32
- 31'. Tunnel with fibrous frass. Larvae bore under bark of recently killed tree and construct U-shaped pupal chamber in heartwood. Ponderosa pine. *Monochamus maculosus* Haldeman spotted pine sawyer

- 32(31). Larvae feed in limbs 1½ inches or more in diameter33
- 32'. Larvae feed in limbs less than 1½ inches in diameter, pupate between two wads of fibrous chips. Ponderosa pine. Adults active from June to August. *Batyle ignicollis ignicollis* (Say) . . .a roundheaded wood borer (fig. 104) *Pogonocherus mixtus* Haldeman a roundheaded wood borer



Figure 104.—Adult *Pogonocherus mixtus* (6-7 mm).
101

- 33(32). Feeds in pine34
 33'. Feeds in Siberian larch. Larvae bore under bark in trunk and larger branches. *Neoclytus muricatus muricatus* (Kirby)a roundheaded wood borer
- 34(33). Larvae bore under bark at the base of dead trees. Ponderosa pine. *Arhopalus foveicollis* (Haldeman) a roundheaded wood borer
- 34'. Larvae bore under bark in trunk and larger branches. Ponderosa pine. (fig. 105) *Neoclytus acuminatus* (F.) redheaded ash borer
Neoclytus muricatus muricatus (Kirby) a roundheaded wood borer
 (fig. 104) *Pogonocherus mixtus* Haldeman a roundheaded wood borer

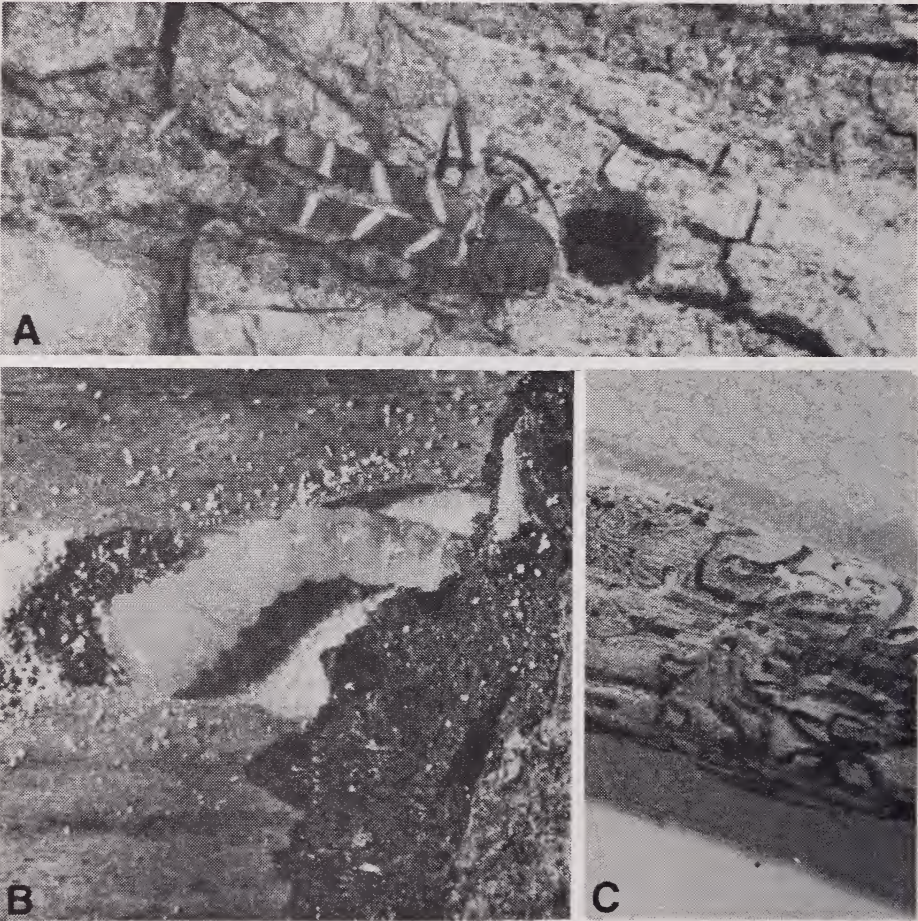


Figure 105.—Redheaded ash borer (*Neoclytus acuminatus*): A, adult and emergence hole; B, larva; C, tunnels.

35(23).	Larvae found in live wood	36
35'.	Larvae found in dead wood	68
36(35).	Larvae tunnel under bark	37
36'.	Larvae tunnel in heartwood	51
37(36).	Larvae bore into root collar (in trunk at ground level)	38
37'.	Larvae not associated with the root collar	39
38(37).	Larvae linear, with sclerotized plates on top of all body segments, pupate under bark or in sapwood. Willow and cottonwood stool beds. <i>Mecas inornata</i> Say	a roundheaded wood borer
38'.	Larvae C-shaped pupate under bark. Willow stool beds. (fig. 106) <i>Lepyrus palustris</i> Scopoli	a weevil



Figure 106.—An adult *Lepyrus palustris* (12 mm).

- 39(37). Larvae bore into trunk or main branches40
 39'. Larvae bore into twigs and side branches46
- 40(39). Tunnels not associated with bark wounds41
 40'. Tunnels associated with bark wounds. Larvae have dorsal thoracic plate marked with inverted "V," pupate under bark. Two-year life cycle. Cottonwood. *Poecilonata cyanipes* (Say) . . . **flatheaded poplar borer**
- 41(40). Tunnels less than 5 inches in length42
 41'. Tunnels more than 5 inches in length44
- 42(41). Tunnel not strongly sinuous43
 42'. Tunnel strongly sinuous (fig. 107), transverse. Unsuccessful attack. Cottonwood. *Agrilus liragus* Barter & Brown **bronze poplar borer**

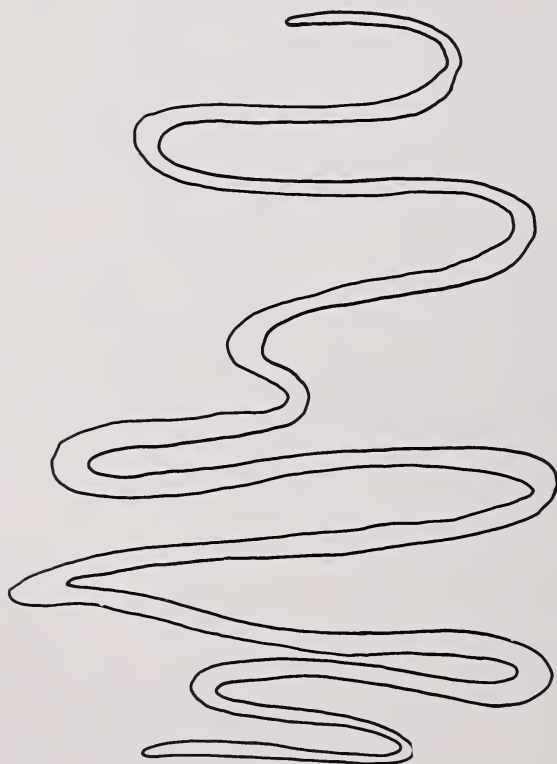


Figure 107.—Gallery of unsuccessful attack of bronze poplar borer (*Agrilus liragus*).

- 43(42). Tunnels radiating from the same point (fig. 108b), unstained, larvae C-shaped (fig. 108a) and pupate under bark. American elm, Siberian elm.
Magdalis armicollis (Say) red elm bark weevil
Magdalis barbata (Say) black elm bark weevil
- 43'. Tunnels parallel to the grain (fig. 109) and originating from a transverse egg gallery. Yellowish foliage in July and August. Green ash. *Leperisinus californicus* Swaine a bark beetle (fig. 110) *Leperisinus aculeatus* Say eastern ash bark beetle



Figure 108.—Bark removed to expose larva of the red elm bark weevil (*Magdalis armicollis*).

- 44(41). Fifth larval body segment longer than wide, spines present on last abdominal segment (fig. 111)45
- 44'. Fifth larval body segment wider than long, spines absent on last abdominal segment (fig. 105b). Green ash. *Neoclytus acuminatus* (F.) .. redheaded ash borer

- 45(44). Found in bur oak. Pupate under bark or in sapwood. Adults active from June to July. *Agrilus obsoleto-guttatus* Gorya flatheaded wood borer
- 45'. Found in cottonwood. Pupate under bark or in sapwood (fig. 107). Adults active from June to July. *Agrilus liragus* Barter & Brown ... bronze poplar borer

- 46(39). Tunnel in branches more than 1½ inches in diameter 47
- 46'. Tunnel in branches less than 1½ inches in diameter .49

- 47(46). Main tunnel meanders under the bark48
- 47'. Main tunnel transverse (egg gallery), stained. Larval tunnels parallel the grain. Yellowish foliage in July and August. Green ash. (fig. 109).
Leperisinus californicus Swainea bark beetle (fig. 110) *Leperisinus aculeatus* Say
..... eastern ash bark beetle

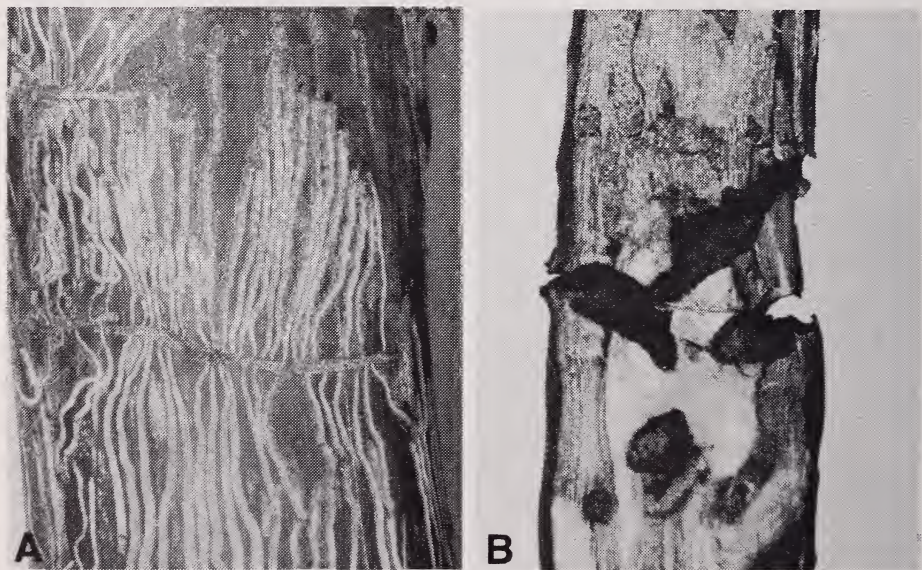
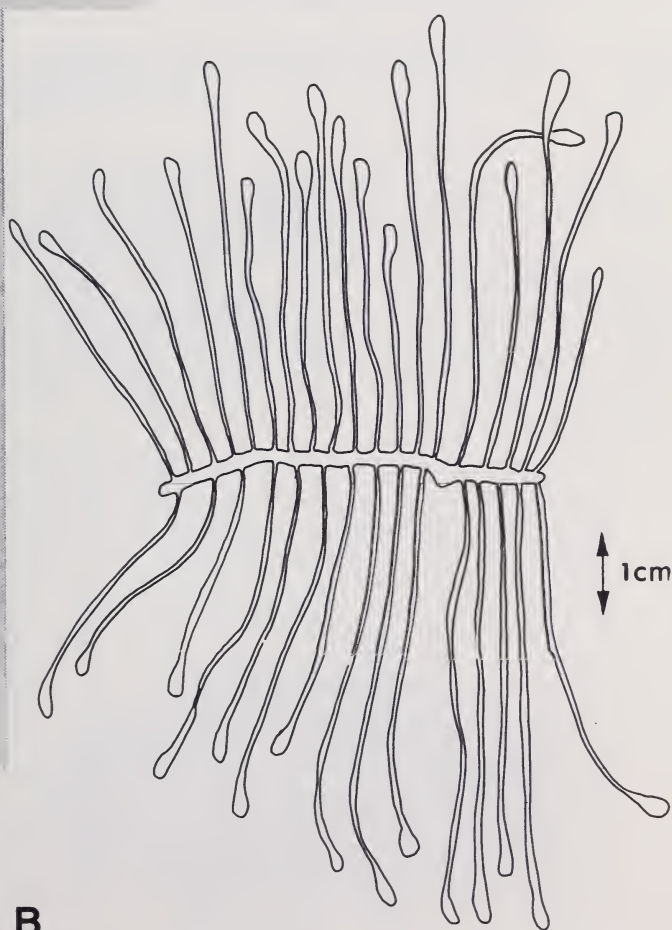


Figure 109.—*Leperisinus californicus*: A, gallery in large branch; B, gallery girdling small branch (note characteristic stain of *Ceratocystis* fungus).



A



B

Figure 110.—Galleries of the eastern ash bark beetle (*Leperisinus aculeatus*): A, galleries in small branch; B, generalized drawing.

- 48(47). Fifth larval body segment longer than wide, spines present on last abdominal segment (fig. 111). Bur oak. Adults active from June to July. *Agrilus obsoleto-guttatus* Gory a flatheaded wood borer
- 48'. Fifth larval body segment wider than long, spines absent on last abdominal segment (fig. 105b). American elm, Siberian elm, green ash. Adults active from June to August. *Neoclytus acuminatus* (F.) redheaded ash borer
- 49(46). Main tunnel meanders under the bark 50
- 49'. Main tunnel transverse (egg gallery), stained. Larval tunnels parallel the grain. Yellowish foliage in July and August. Green ash. (fig. 109). *Leperisinus californicus* Swaine a bark beetle (fig. 110) *Leperisinus aculeatus* Say eastern ash bark beetle

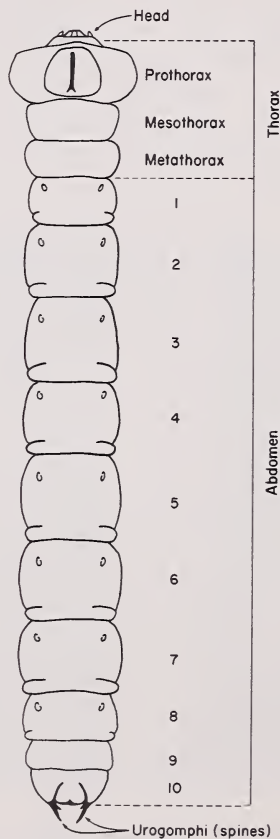


Figure 111.—Generalized drawing of an *Agrilus* larva.

- 50(49). Larvae with 5th body segment longer than wide, spines present on last abdominal segment (fig. 111). Meandering or zigzag mine alternates between bark and sapwood. Bur oak. Adults present from May to July. *Agrilus bilineatus* (Weber) . . . twolined chestnut borer
- 50'. Larvae with 5th body segment wider than long, spines absent on last abdominal segment. Meandering mines at base of twigs. Willow and cottonwood stool beds. Adults active during July. *Mecas inornata* Say
. a roundheaded wood borer
- 51(36). Bores into root collar or roots52
- 51'. Bores into wood more than 6 inches aboveground . .57
- 52(51). Found in roots53
- 52'. Found in root collar54
- 53(52). Found in cottonwood stool beds. Tunnel ¼ inch in diameter. Head light to dark brown, abdominal prolegs (fig. 7) present. *Aegeria tibialis* (Harris)
. a clearwinged moth
- 53'. Found in bur oak. Tunnel ½ inch in diameter. Head black, abdominal prolegs absent. Adults (fig. 112) present from July to August. *Prionus imbricornis* (L.)
. tilehorned prionus



Figure 112.—Tilehorned prionus (*Prionus imbricornis*).

- 54(52). Larvae infest willow or cottonwood55
- 54'. Larvae infest green ash, tunnel $\frac{1}{4}$ inch or less in diameter (plate 5; fig. 113). Larva white with light brown head. Two-year life cycle. Adults present from May to September. *Podosesia syringae fraxini* Lugger
 ash borer



Figure 113.—Damage of the ash borer (*Podosesia syringae fraxini*) in green ash. Note cast pupal skin.

- 55(54). Larvae linearly narrow56
- 55'. Larvae C-shaped, similar to figure 108a, tunnel under bark and in sapwood, construct pupal chamber upward in the heartwood. Willow and cottonwood stool beds. Adults (fig. 16) active from July to September. *Cryptorhynchus lapathi* (L.). . poplar-and-willow borer

- 59(58). Tunnel packed with granular frass60
- 59'. Tunnel without frass61
- 60(59). Tunnel round in cross section. Larva with spine on end of abdomen (fig. 114). American elm, Siberian elm. *Tremex columba* (L.) **pigeon tremex**
- 60'. Tunnel elliptical in cross section. Larva without spine on end of abdomen, dorsal thoracic plate marked with an inverted "V" (fig. 115). Green ash. *Dicerca divaricata* (Say) **a flatheaded wood borer**

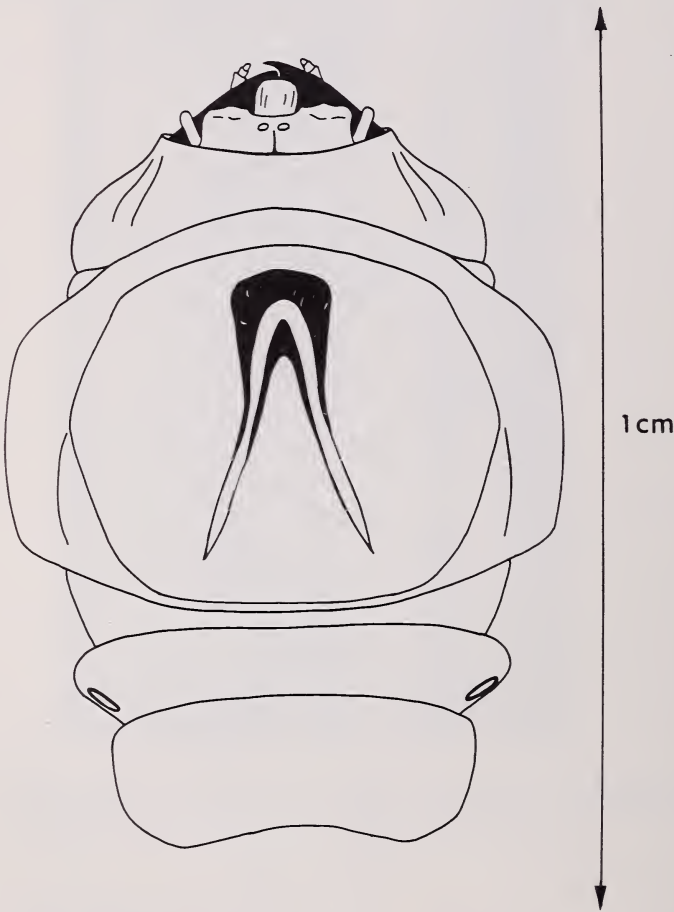


Figure 115.—Larva of *Dicerca divaricata*.

- 61(59). Tunnel $\frac{1}{4}$ inch or less in diameter (fig. 113). Larva white with light brown head (plate 5). Two-year life cycle. Green ash. Adults present from May to September. *Podosesia syringae fraxini* Lugger ash borer
- 61'. Tunnel $\frac{1}{2}$ inch or less in diameter (fig. 116). Larva light green to reddish white (plate 8) with dark brown head. Three-year life cycle. Willow, green ash, American elm, Siberian elm. Adults present from June to July. *Prionoxystus robiniae* (Peck) carpenterworm



Figure 116.—Multiple attacks on green ash by the carpenterworm (*Prionoxystus robiniae*). Note empty pupa cases.

- 62(58). Tunnel packed with granular frass63
 62'. Tunnel without frass64
- 63(62). Tunnel round in cross section. Larva with spine on end of abdomen (fig. 114). Boxelder, American elm, Siberian elm. *Tremex columba* (L.) . . . pigeon tremex
- 63'. Tunnel elliptical in cross section. Larva without spine on end of abdomen, dorsal thoracic plate marked with an inverted "V" (fig. 115). Boxelder, cottonwood. (fig. 117a) *Dicerca divaricata* (Say)
 a flatheaded wood borer
 (fig. 117b) *Dicerca tenebrica* (Kirby)
 a flatheaded wood borer



Figure 117.—*Dicerca* spp.: A, *Dicerca divaricata* (note divergent wing tips); B, *Dicerca tenebrica*.

- 64(62). Larva with brown retracted head, body white, abdominal prolegs absent (fig. 118). Cottonwood. *Saperda calcarata* Say poplar borer
- 64'. Larva with dark brown visible head, body light to reddish white (plate 8), abdominal prolegs present. Boxelder, cottonwood. *Prionoxystus robiniae* (Peck) carpenterworm

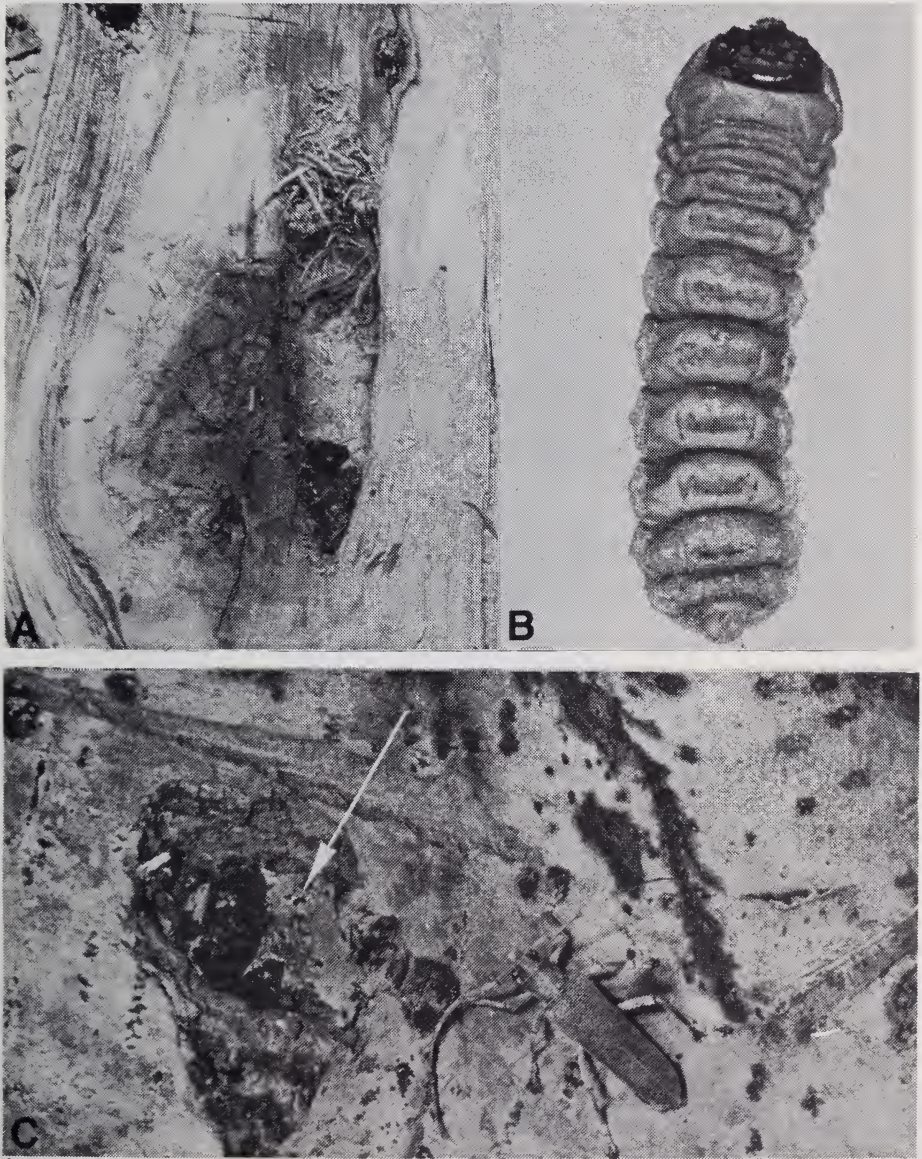


Figure 118.—Poplar borer (*Saperda calcarata*): A, pupal cell with frass plug; B, larva (ventral view); C, adult with bark depression indicating an attack.

- 65(57). Larvae infest willow, cottonwood66
- 65'. Larvae infest bur oak, boxelder, hackberry, green ash
..... 67

- 66(65). Larvae C-shaped, similar to figure 108a. Bore under bark and in sapwood, construct pupal chamber upward in heartwood. Willow, cottonwood. Adults (fig. 16) present from July to September. *Cryptorhynchus lapathi* (L.)..... poplar-and-willow borer
- 66'. Larvae S-shaped (fig. 119). Bores down pith of twig, pupates in pith. Willow stool bed. Adults present from May to June. *Janus abbreviatus* (Say)
.....willow shoot sawfly

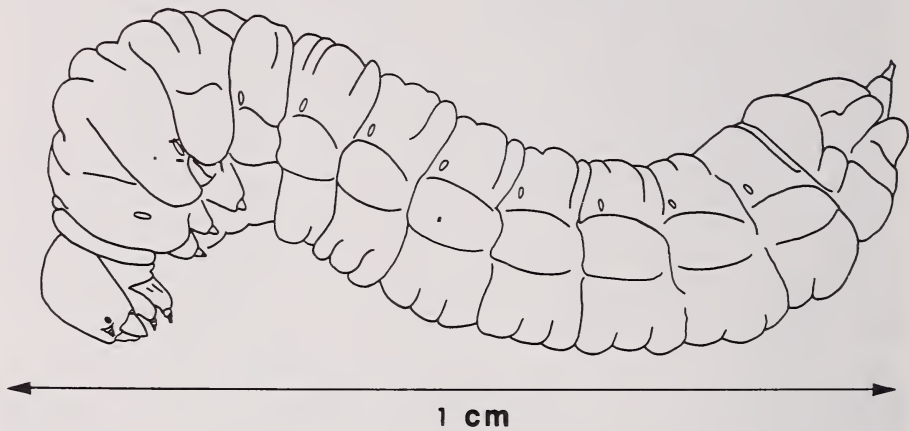


Figure 119.—Willow shoot sawfly (*Janus abbreviatus*).

- 67(65). Larvae prune twig and pupate in portion attached to tree. Larva white with retracted head, tunnel in twig pith. Bur oak, green ash. Adults present from June to August. *Psyrassa unicolor* (Randall) a twig pruner
- 67'. Larvae prune twig and pupate in severed twig between two fibrous wads. Larva white with retracted head (fig. 120), tunnel in twig pith. Bur oak, boxelder, green ash, hackberry. Adults present from June to July. *Elaphidionoides villosus* (F.)twig pruner



Figure 120.—Twig pruner (*Elaphidionoides villosus*): A, dorsal view of larva with pruned oak twig; B, lateral view of larva.

- | | | |
|---------|--|---------------|
| 68(35). | Wood in state of decay, bark absent | 69 |
| 68'. | Dry wood, bark intact | 71 |
| 69(68). | Larvae with depressed body, head retracted | 70 |
| 69'. | Larvae with cylindrical white body, head visible (fig. 114), end of abdomen with brown spine. Tunnel in heartwood. Boxelder, American elm, Siberian elm. Larvae present from June to following May. <i>Tremex columba</i> (L.) | pigeon tremex |

- 70(69). Larvae with dorsal thoracic plate marked with inverted "V." Tunnel under bark. Cottonwood. *Poecilonata cyanipes* (Say) flatheaded poplar borer
- 70'. Larvae with dorsal thoracic plate unmarked. Tunnel in sapwood. Willow. *Saperda mutica* Say
..... a roundheaded wood borer
- 71(68). Larvae C-shaped, cylindrical, short72
- 71'. Larvae linear, depressed, long74
- 72(71). Infest dead or dying elm73
- 72'. Infest dead ash twigs. Transverse unstained gallery, 1 inch larval mines parallel to wood grain, numerous attacks on the same tree. Green ash. (fig. 121) *Leperisinus fasciatus* LeConte
..... whitebanded ash bark beetle
(fig. 122) *Leperisinus criddlei* Swaine
..... an ash bark beetle

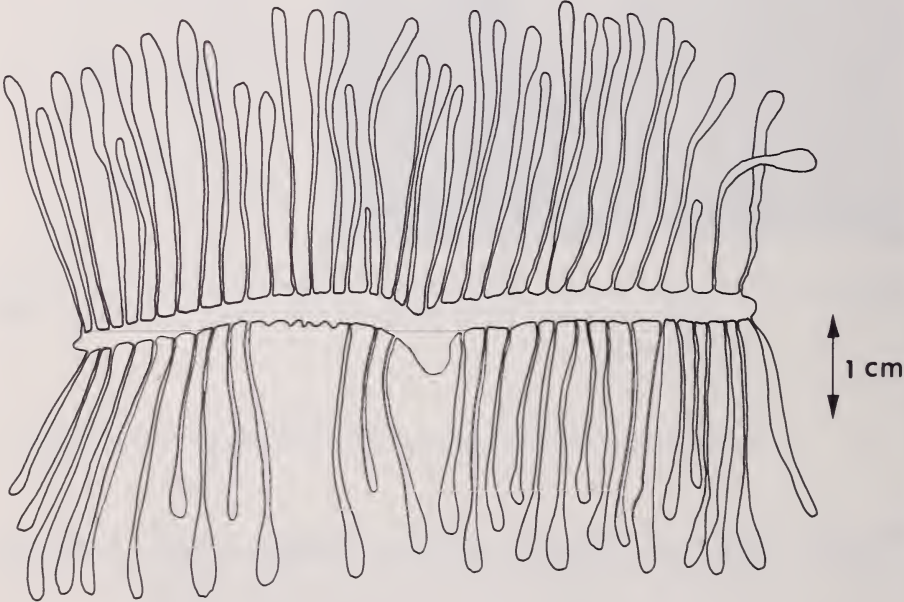


Figure 121.—Gallery of whitebanded ash bark beetle (*Leperisinus fasciatus*).



Figure 122.—Galleries of *Leperisinus criddlei*.

- 73(72). Main gallery transverse, larvae mine parallel to grain, fan-shaped pattern (fig. 123). American elm. *Hylurgopinus rufipes* (Erichhoff) . . . native elm bark beetle
- 73'. Main gallery parallel to grain, transverse larval mines, fan-shaped pattern (fig. 124). American elm. *Scolytus multistriatus* (Marsham)
- smaller European elm bark beetle

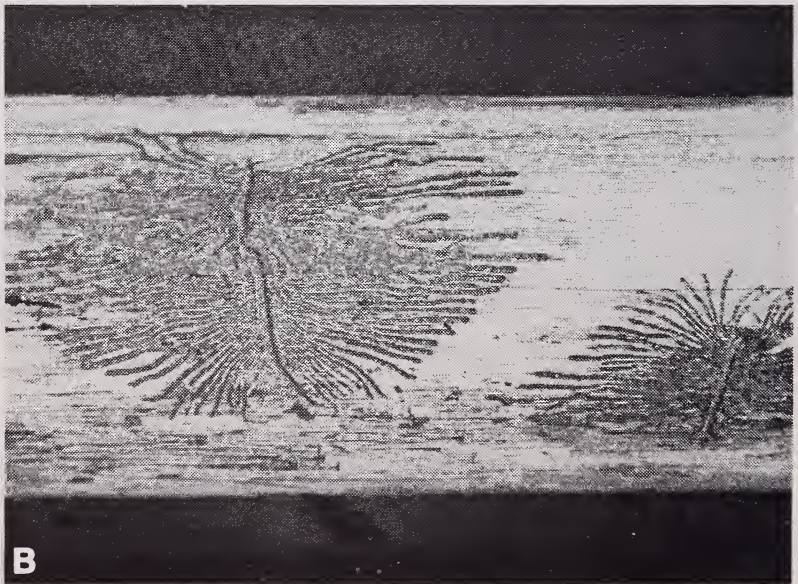
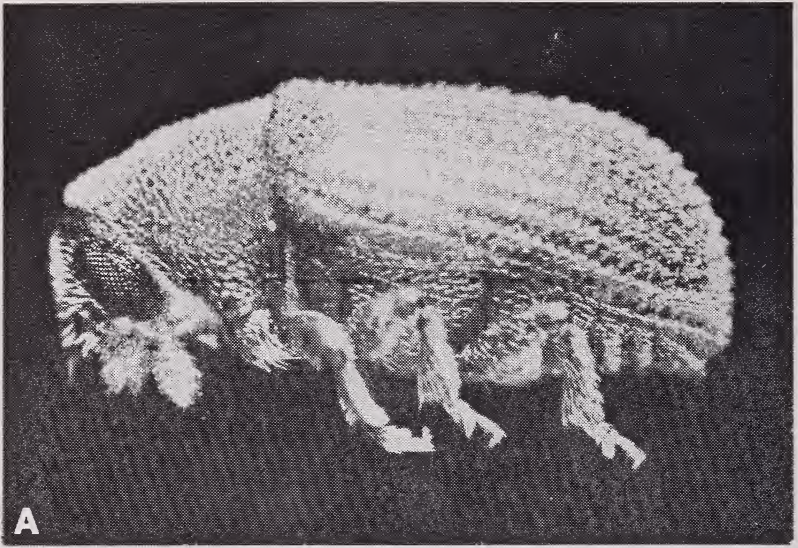


Figure 123.—Native elm bark beetle (*Hylurgopinus rufipes*): A, adult; B, egg gallery and larval mines.

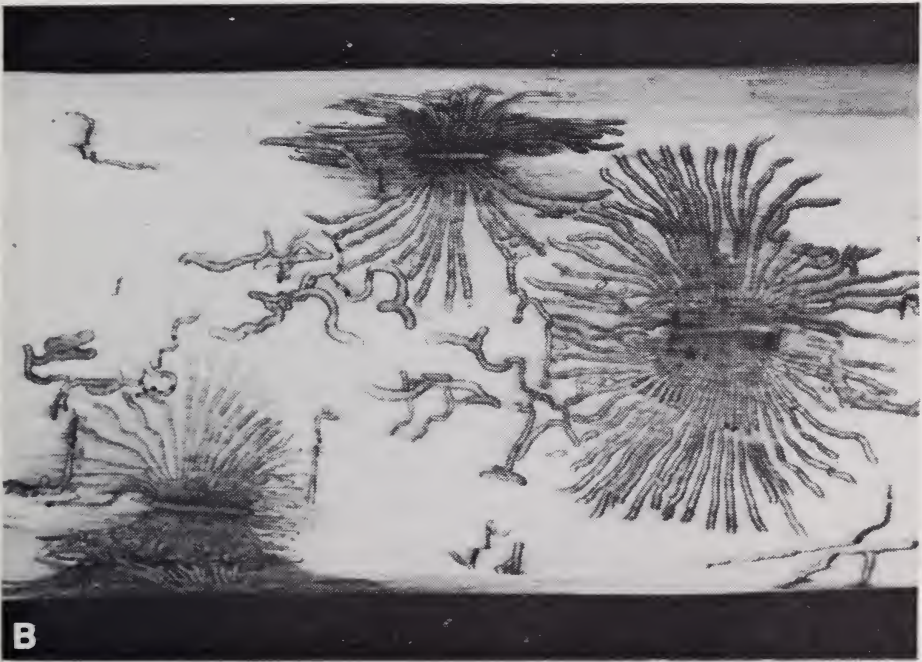


Figure 124.—Smaller European elm bark beetle (*Scolytus multi-striatus*): A, adult; B, brood galleries on American elm made by female beetles and larvae.

74(71).	Larvae tunnel in center of twig	75
74.	Larvae tunnel under bark	76

- 75(74). Larvae pupate between two wads of fibrous chips in center of twig. Bur oak. Adults present from May to August. *Batyle saturalis saturalis* (Say) a roundheaded wood borer
- 75'. Larvae pupate using only one fibrous wad, excavate emergence hole before pupation. Bur oak, boxelder, hackberry. Adults present from May to July. *Elaphidion mucronatum* (Say)spined bark borer
- 76(74). Larvae infest bur oak, boxelder, hackberry77
- 76'. Larvae infest cottonwood, green ash, American elm, Siberian elm81
- 77(76). Dorsal thoracic plate marked (fig. 125)78
- 77'. Dorsal thoracic plate unmarked80

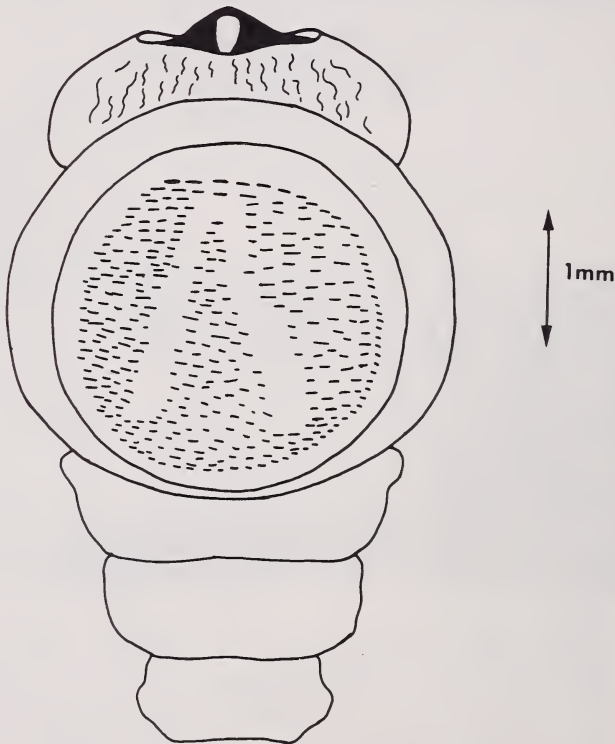


Figure 125.—*Chrysobothris sexsignata* (dorsal view).

- 78(77). Dorsal thoracic plate with median bisecting line (fig. 111), last abdominal segment with spines (fig. 126)
79
- 78'. Dorsal thoracic plate marked with inverted "V" (fig. 125), last abdominal segment without spines. Bur oak, boxelder. *Chrysobothris sexsignata* (Say)
 a flatheaded wood borer

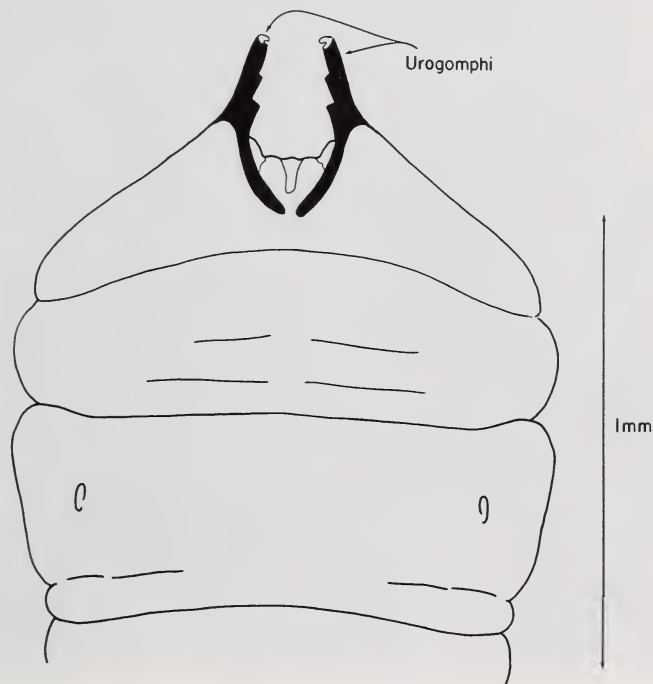


Figure 126.—Dorsal view of last abdominal segments showing spines (*Agrilus* spp.).

- 79(78). Infest boxelder. Meandering galleries just scoring wood surface (fig. 127). *Agrilus masculinus* LeConte
 a flatheaded wood borer
- 79'. Infest hackberry. Meandering galleries just scoring wood surface.
Agrilus celti Knull a flatheaded wood borer
Agrilus lecontei Saunders ... a flatheaded wood borer.



Figure 127.—Bark removed to show damage of *Agrilus masculinus* on dead boxelder (note “D” shaped emergence holes).

- 80(77). Larvae mine under bark of dead dry twigs, construct pupal chamber under bark or in sapwood. Boxelder. *Hyperplatys aspersus* (Say)
 a roundheaded wood borer
Hyperplatys maculatus Haldeman
 a roundheaded wood borer
- 80'. Larvae mine under bark of live twig the first year, construct long pupal chamber down center of twig the second year. Bur oak, boxelder, hackberry. Adults present from May to July. *Elaphidion mucronatum* (Say) spined bark borer

81(76).	Tunnels with tightly packed granular frass	82
81'.	Tunnels with fibrous frass. Larvae score bark more than wood, pupate in bark or sapwood. American elm, Siberian elm. <i>Saperda tridentata</i> Olivier	elm borer
82(81).	Dorsal thoracic plate marked (fig. 125)	83
82'.	Dorsal thoracic plate unmarked	84
83(82).	Dorsal plate marked with a single bisecting line (fig. 111), last abdominal segment with spines (fig. 126). Larvae tunnel under bark, pupate in sapwood. Green ash. <i>Agrilus</i> sp	a flatheaded wood borer
83'.	Dorsal plate marked with inverted "V" (fig.125), last abdominal segment without spines. American elm, Siberian elm, green ash. <i>Chrysobothris sexsignata</i> (Say)	a flatheaded wood borer
84(82).	Larvae infest cottonwood. Meandering tunnels under bark just score the wood, pupate under bark or in sapwood. <i>Hyperplatys aspersus</i> (Say)	a roundheaded wood borer
	<i>Hyperplatys maculatus</i> Haldeman	a roundheaded wood borer
84'.	Larvae infest green ash. Meandering tunnels under bark generally parallel the wood grain (fig. 105), pupate within inch of wood surface. <i>Neoclytus acuminatus</i> (F.)	redheaded ash borer
	<i>Obrium ruffulum</i> Gahan	a roundheaded wood borer

WOOD BORERS, BY POINT OF ATTACK

B = branches, C = root collar, K = trunk, P = twig pruner, R = roots, T = twigs

Insect	American elm	Blue spruce	Boxelder	Bur oak	Cotton-wood	Green ash	Hackberry	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
FOUND UNDER BARK OF LIVE TREES											
<i>Agrilus bilineatus</i> (twolined chestnut borer)				T							
<i>Agrilus liragus</i> (bronze poplar borer)					K						
<i>Agrilus obsoletoguttatus</i> (a flatheaded wood borer)				K, B							
<i>Dicerca divaricata</i> (a flatheaded wood borer)			K, B		K, B	K, B					
<i>Dicerca tenebrica</i> (a flatheaded wood borer)					K						
<i>Leperisinus aculeatus</i> (eastern ash bark beetle)						K, B					
<i>Leperisinus californicus</i> (a bark beetle)						K, B					
<i>Lepyrus palustris</i> (a weevil)											C
<i>Magdalis armicollis</i> (red elm bark weevil)	K								K		
<i>Magdalis barbata</i> (black elm bark weevil)	K								K		

WOOD BORERS, BY POINT OF ATTACK

B = branches, C = root collar, K = trunk, P = twig pruner, R = roots, T = twigs

Insect	American elm	Blue spruce	Boxelder	Bur oak	Cotton-wood	Green ash	Hackberry	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
FOUND UNDER BARK OF LIVE TREES											
<i>Mecas inornata</i> (a roundheaded wood borer)					T, C				T, C		
<i>Neoclytus acuminatus</i> (redheaded ash borer)	K, B					K, B			K, B		
<i>Pissodes strobi</i> (white pine weevil)		B									
<i>Poecilmona cyanipes</i> (flatheaded poplar borer)					K, B						
FOUND IN HEARTWOOD OF LIVE TREES											
<i>Aegeria tibialis</i> (a clearwinged moth)					C, R						
<i>Cryptorhynchus lapathi</i> (poplar-and-willow borer)					K, C						K, C
<i>Dicerca divaricata</i> (a flatheaded wood borer)	K, B			K, B	K, B						
<i>Dicerca tenebrica</i> (a flatheaded wood borer)				K, B	K, B						
<i>Elaphidionoides villosus</i> (twig pruner)	P		P	P		P	P				

WOOD BORERS, BY POINT OF ATTACK

B = branches, C = root collar, K = trunk, P = twig pruner, R = roots, T = twigs

Insect	American elm	Blue spruce	Boxelder	Bur oak	Cotton-wood	Green ash	Hackberry	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
FOUND IN HEARTWOOD OF LIVE TREES											
<i>Janus abbreviatus</i> (willow shoot sawfly)											T
<i>Neolytus acuminatus</i> (redheaded ash borer)	T, B					T, B					
<i>Petrova luculentana</i> (pine pitch-nodule maker)								T			
<i>Podosesia syringae fraxini</i> (ash borer)						K, B					
<i>Prionoxystus robiniae</i> (carpenterworm)			K		K	K			K		K
<i>Prionus imbricornis</i> (tilehorned prionus)				R							
<i>Proteoteras willingana</i> (boxelder twig borer)			T								
<i>Rhyacionia bushnelli</i> (western pine tip moth)								T			
<i>Saperda calcarata</i> (poplar borer)					K, B						
<i>Tremex columba</i> (pigeon tremex)	K		K								

WOOD BORERS, BY POINT OF ATTACK

B = branches, C = root collar, K = trunk, P = twig pruner, R = roots, T = twigs

Insect	American elm	Blue spruce	Boxelder	Bur oak	Cotton-wood	Green ash	Hackberry	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
FOUND IN DEAD AND DYING TREES											
<i>Agrilus celti</i> (a flatheaded wood borer)							B				
<i>Agrilus lecontei</i> (a flatheaded wood borer)							B				
<i>Agrilus masculinus</i> (a flatheaded wood borer)			K, B								
<i>Batyte saturalis saturalis</i> (a roundheaded wood borer)				T							
<i>Chrysobothris sexsignata</i> (a flatheaded wood borer)	B		B	B		B			B		
<i>Elaphidion mucronatum</i> (spined bark borer)			P	P			P				
<i>Hylurgopinus rufipes</i> (native elm bark beetle)	K, B										
<i>Hyperplatys aspersus</i> (a roundheaded wood borer)			T, B		T, B						
<i>Hyperplatys maculatus</i> (a roundheaded wood borer)			T, B		T, B						
<i>Leperisinus criddlei</i> (an ash bark beetle)						K, B					

WOOD BORERS, BY POINT OF ATTACK

B = branches, C = root collar, K = trunk, P = twig pruner, R = roots, T = twigs

Insect	American elm	Blue spruce	Boxelder	Bur oak	Cotton-wood	Green ash	Hackberry	Ponderosa pine	Siberian elm	Siberian peashrub	White willow
FOUND IN DEAD AND DYING TREES											
<i>Leperisinus fasciatus</i> (whitebanded ash bark beetle)						K, B					
<i>Neoclytus acuminatus</i> (redheaded ash borer)	K, B					K, B					
<i>Obrium ruffulum</i> (a roundheaded wood borer)						B					
<i>Poecilmona cyanipes</i> (flatheaded poplar borer)					K						
<i>Saperda mutica</i> (a roundheaded wood borer)											K
<i>Saperda tridentata</i> (elm borer)	K, B								K, B		
<i>Scolytus multistriatus</i> (smaller European elm bark beetle)	K, B										
<i>Tremex columba</i> (pigeon tremex)	K		K						K		

SECTION IV. SAP-SUCKING INSECTS

Insects feeding on plant sap produce puncture wounds, stippled discoloration, or leaf curls; scale insects.

1. Insects are covered with shell or pitch mass, immobile 2
- 1'. Insects are free feeding or found within a leaf curl, mobile 7
- 2(1). Found on evergreens 3
- 2'. Found on hardwoods 5
- 3(2). Soft-bodied insect covered with a shell (scale) 4
- 3'. Maggot covered with pitch mass. Ponderosa pine, blue spruce. *Cecidomyia reeksi* Vockeroth . . . a pitch midge
- 4(3). Scale white with brown cap (fig. 128). Ponderosa pine, Scotch pine, white spruce, blue spruce. Summer. *Phenacaspis pinifoliae* (Fitch) pine needle scale
- 4'. Scale brown, round, deeply concave. White spruce, blue spruce. Summer. *Toumeyella* sp. . a tortoise scale



Figure 128.—Pine needle scale (*Phenacaspis pinifoliae*) on spruce.

- 5(2). Absence of marginal secretion around edge of scale
 6
- 5'. Presence of flocculent material around edge of scale
 (fig. 129), $\frac{1}{4}$ inch in diameter. Green ash, boxelder,
 silver maple. Summer. *Pulvinaria innumerabilis*
 (Rathvon) cottony maple scale



Figure 129.—Cottony maple scale (*Pulvinaria innumerabilis*).

- 6(5). Scale gray to dark brown, dark central nipple; 1/16 inch in diameter. Cottonwood, green ash, boxelder, hackberry. *Aspidiotus ancylus* (Putnam) Putnam scale
- 6'. Scale brown (fig. 130), 3/16 inch in diameter. Green ash, boxelder, American elm, Siberian elm. Summer. *Lecanium corni* Bouche European fruit lecanium



Figure 130.—European fruit lecanium (*Lecanium corni*) on green ash.

- 7(1). Found on evergreens8
- 7'. Found on hardwoods9
- 8(7). Found on white spruce or blue spruce. Trace of webbing between discolored needles. Mite barely visible to naked eye. *Tetranychus urticae* Koch twospotted spider mite
- 8'. Found on ponderosa pine and Scotch pine. No webbing associated with discolored needles. Aphids with cornicle (fig. 134), body dark brown to black. Aphids present from July to August. *Cinara* sp. . . a pine aphid
- 9(7). Adults with wings, rest flat on back. (fig. 131, 133), hind wings approximately same size as front wings 10
- 9'. Adults with or without wings. If present, held above the abdomen, hind wing much smaller than front wing. (fig. 134)14
- 10(9). Wings highly sculptured (fig. 131)11
- 10'. Wings not sculptured12

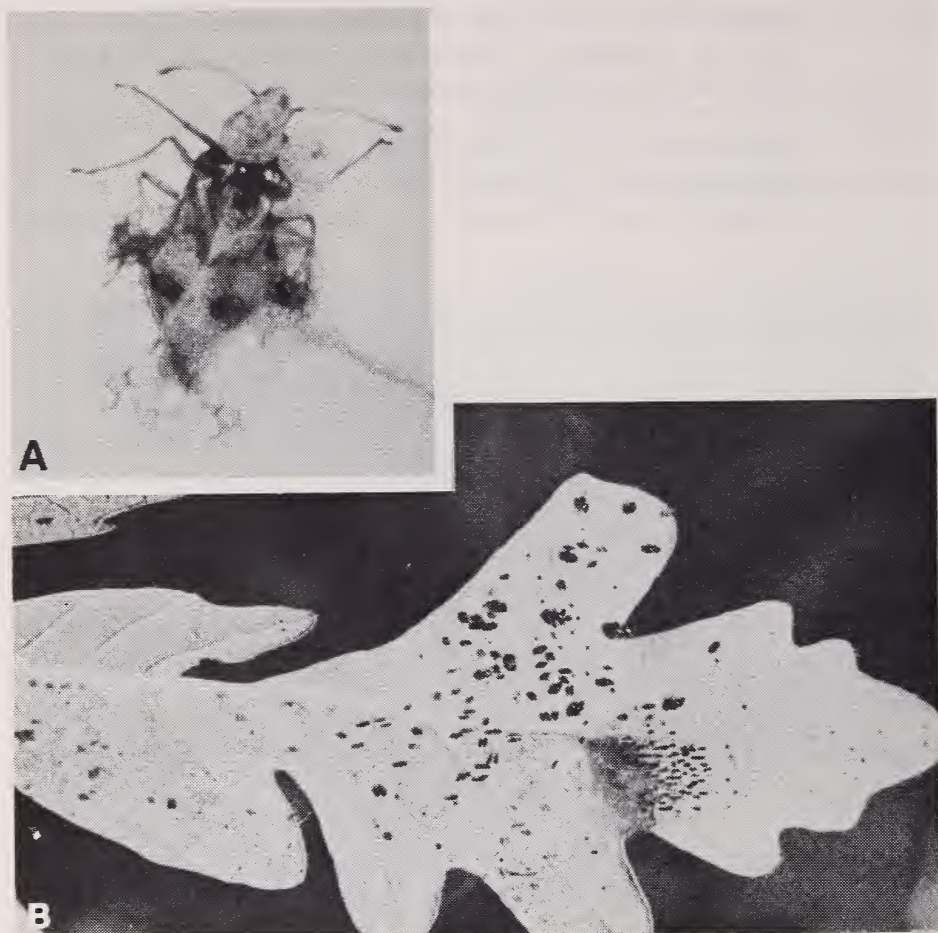


Figure 131.—Oak lace bug (*Corythucha arcuata*): A, adult; B, nymphs on bur oak.

- 11(10). Found on bur oak (fig. 131). Leaves discolored. Insect present from mid to late summer. *Corythucha arcuata* (Say) oak lace bug
- 11'. Found on American elm and Siberian elm. Leaves discolored. Insect present from mid to late summer. *Corythucha ulmi* Osborn & Drake elm lace bug
- 12(10). Stippled discoloration on boxelder and Siberian elm 13
- 12'. Stippled discoloration on green ash (fig. 132a). Wings light tan with pinkish markings (fig. 132b). Insect present from June to October. *Neoborus amoenus* (Reuter) ash plant bug



Figure 132.—Ash plant bug (*Neoborus amoenus*): A, damage; B, adult.

- 13(12). Found on Siberian peashrub. Insect red with black median stripe, wing tip black. Insects present from July to September. *Lopidea* sp a plant bug
- 13'. Found on boxelder. Insect black with three longitudinal red lines on pronotum (fig. 133), wing edge marked with red. Insects present from August to October. *Leptocoris trivittatus* (Say) . . . boxelder bug

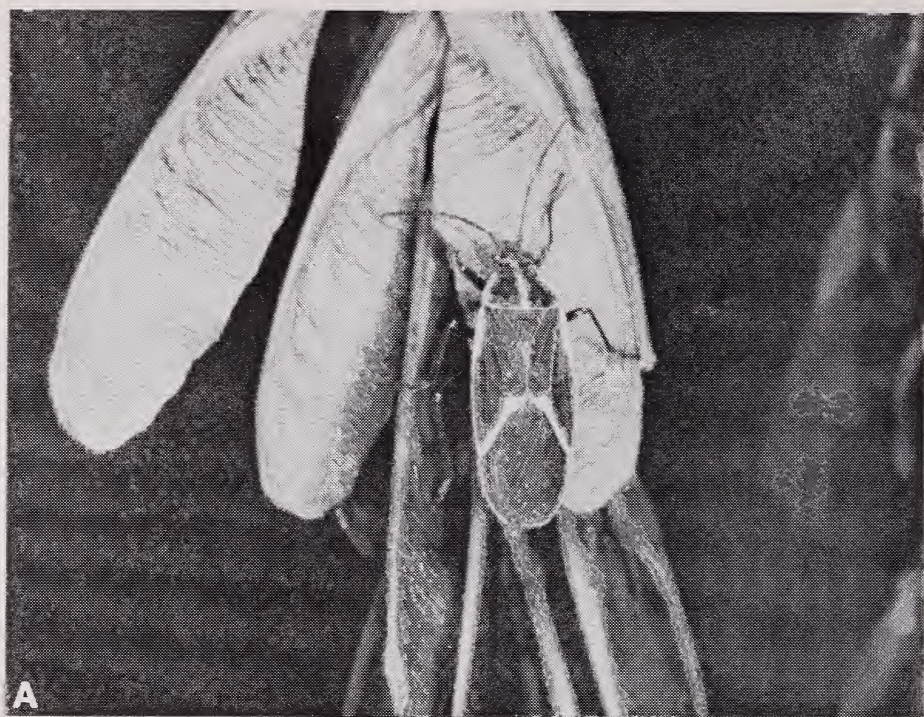


Figure 133.—Boxelder bug (*Leptocoris trivittatus*): A, adult; B, nymphs.

14(9).	Aphids on	
	Boxelder, Siberian peashrub	15
	Cottonwood	16
	Willow	17
	American plum	18
	Common chokecherry	19
	Green ash	20
	American elm	21
15(14).	Found on leaves and twigs of boxelder. Body light to dark olive green, cornicle pale green (fig. 134). <i>Periphyllus negundinis</i> (Thomas)	boxelder aphid
15'.	Found on leaves and seed pods of Siberian peashrub. Body and cornicle (fig. 134) light green. <i>Acyrtosiphon caraganae</i> (Cholodkovsky)	caragana aphid

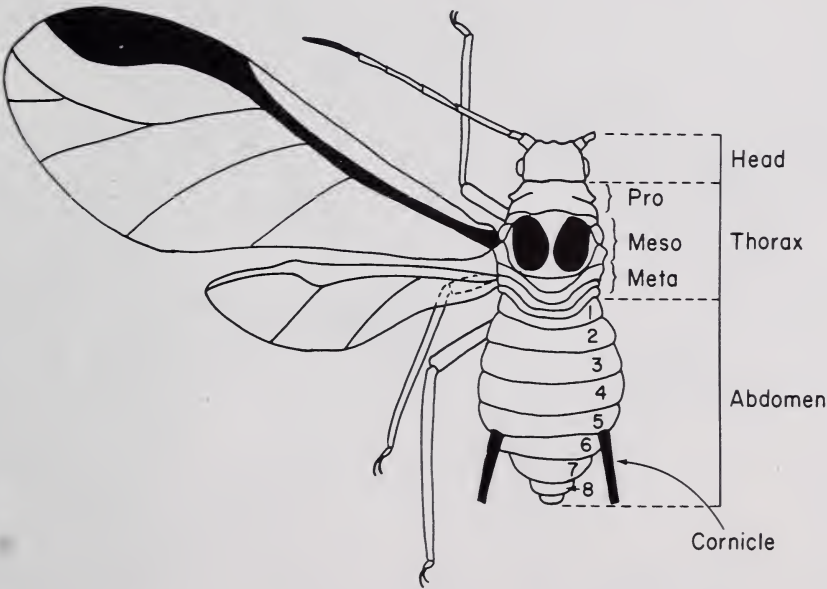


Figure 134.—Generalized drawing of a winged aphid.

- 16(14). Body greenish yellow, cornicle (fig. 134) short. Aphids found on leaves and twigs of cottonwood. *Neothomasia populicola* (Thomas)
 cloudywinged cottonwood leaf aphid
 16'. Body green to reddish brown, cornicle (fig. 134) long. Aphids found on twigs of cottonwood. *Pterocomma populifoliae* (Fitch) reddishbrown poplar aphid
- 17(14). Body yellow to dark reddish brown (plate 4; fig. 135), antenna hairy. Found on twigs of willow. *Pterocomma* sp a willow aphid
 17'. Body pale green, antenna (fig. 134) hairless. Found on leaves of willow. *Cavariella* sp a willow aphid

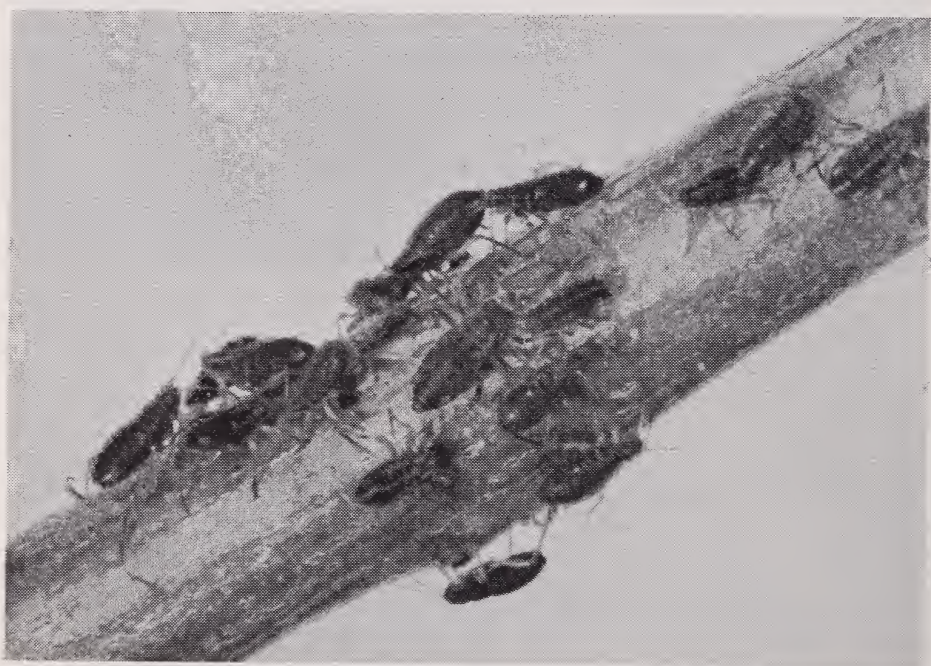


Figure 135.—A willow aphid (*Pterocomma* sp.) on white willow.

- 18(14). Body dark brown, head and thorax dark brown to black, cornicle (fig. 134) present. Found on twigs and curled leaves of American plum. *Aphis setariae* (Thomas) **rusty plum aphid**
- 18'. Body yellowish green, head and thorax (fig. 134) dark brown to black, cornicle absent. Found on twigs and curled leaves of American plum. *Asiphonaphis pruni* Wilson & Davis **a plum aphid**

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APPENDIX

GLOSSARY

- Anal:** Pertaining to the last segment of the abdomen.
- Caudal:** Pertaining to the anal end of the insect body.
- Cervical:** Relating or belonging to the neck.
- Cornicle:** The terminal dorsal erect horns or rounded projections on aphids.
- Dorsal:** Of or belonging to the upper surface.
- Elytra:** The anterior leathery or chitinous wings of beetles, serving as coverings to the hind wings, commonly meeting in a straight line down the middle of dorsum in repose.
- Facet:** A small face or surface.
- Flocculent:** Consisting of soft flakes.
- Frass:** Solid excrement of insects; wood residue left by boring insects.
- Larva:** An insect which hatches from the egg and differs fundamentally in form from the adults.
- Mesothorax:** The second or middle thoracic segment which bears the middle pair of legs.
- Proleg:** Any process or appendage that serves the purpose of a leg; specifically the fleshy unjointed abdominal legs of caterpillars and certain sawfly larvae.
- Pronotum:** The upper or dorsal surface of the prothorax.
- Prothorax:** The first thoracic segment which bears the anterior pair of legs.
- Punctate:** Set with impressed points or punctures.
- Rugosities:** Wrinkles.
- Scolus:** Tubercles in the form of spinose projections on the body wall of certain caterpillars.

- Setae:** Slender, hairlike appendages.
- Spiracle:** Lateral openings on the segments of the insect body through which air enters.
- Suture:** The line of juncture between the elytra of a beetle.
- Thorax:** The second region of the insect body bearing the true legs and wings; made up of three segments: prothorax, mesothorax, and metathorax.
- Tubercle:** A small abrupt elevation of varying form; a little solid pimple or small button; in caterpillars, tubercles sometimes bear setae.

LIST OF TREES AND SHRUBS MENTIONED IN KEY

Common name	Botanical name
Boxelder	<i>Acer negundo</i> L.
Silver maple	<i>Acer saccharinum</i> L.
Saskatoon serviceberry	<i>Amelanchier alnifolia</i> (Nutt.) Nutt.
Paper birch	<i>Betula papyrifera</i> Marsh.
Siberian peashrub	<i>Caragana arborescens</i> Lamarch
Hackberry	<i>Celtis occidentalis</i> L.
Peking cotoneaster	<i>Cotoneaster acutifolia</i> Turczaninow
Russian-olive	<i>Elaeagnus angustifolia</i> L.
Green ash	<i>Fraxinus pennsylvanica</i> Marsh.
Tamarack	<i>Larix laricina</i> (Du Roi) K. Koch
Tatarian honeysuckle	<i>Lonicera tatarica</i> L.
Apple	<i>Malus</i> spp.
White spruce	<i>Picea glauca</i> (Moench) Voss
Blue spruce	<i>Picea pungens</i> Engelm.
Ponderosa pine	<i>Pinus ponderosa</i> Laws.
Scotch pine	<i>Pinus sylvestris</i> L.
Cottonwood	<i>Populus deltoides</i> Bartr.
Aspen	<i>Populus</i> spp.
American plum	<i>Prunus americana</i> Marsh.
Sand cherry	<i>Prunus pumila</i> L.
Common chokecherry	<i>Prunus virginiana</i> L.
Bur oak	<i>Quercus macrocarpa</i> Michx.
Rose	<i>Rosa</i> spp.
White willow	<i>Salix alba</i> L.
Willow	<i>Salix</i> spp.
Common lilac	<i>Syringa vulgaris</i> L.
American basswood	<i>Tilia americana</i> L.
American elm	<i>Ulmus americana</i> L.
Siberian elm	<i>Ulmus pumila</i> L.

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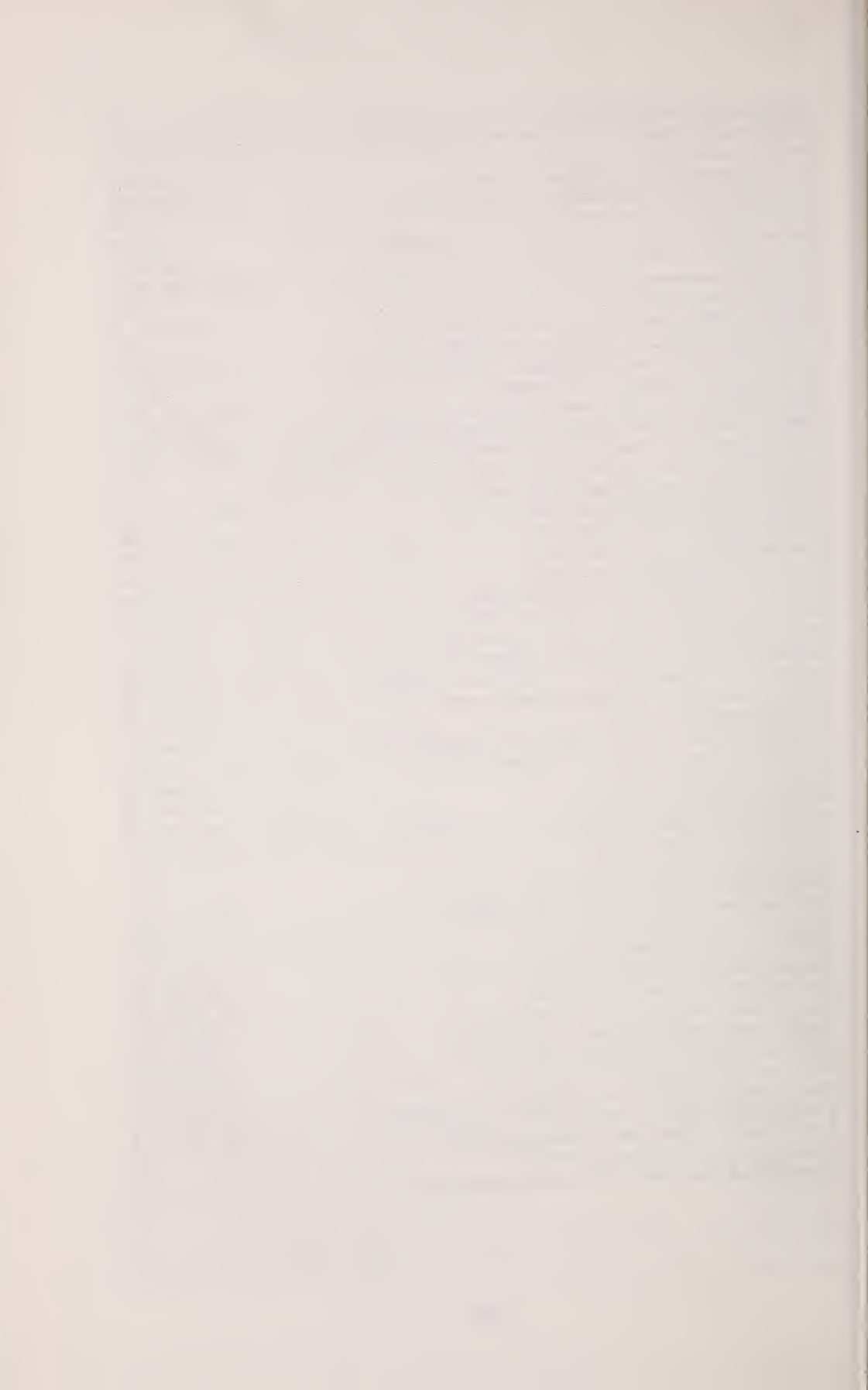
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An insect key designed to help identify 227 insect species. The text contains 136 figures and 8 color plates to aid in identification. Several tables assist in coordinating host damage with a particular insect species.

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MARGIN INDEX

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MAJOR DAMAGE CATEGORIES

DEFOLIATING INSECTS

GALL-MAKING INSECTS AND MITES

BORING AND LEAF-MINING INSECTS

SAP-SUCKING INSECTS